MECHANICAL ENGINEERING

INCLUDING THE ENGINEERING INDEX

A.S.M.E. SPRING MEETING

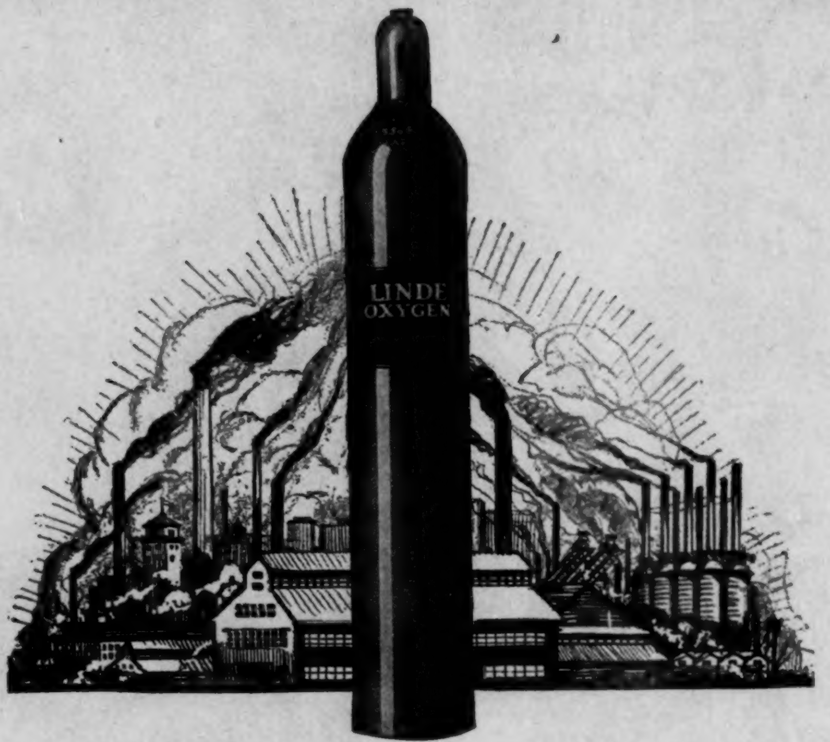
THE Spring Meeting of the A.S.M.E. to be held in Atlanta, May 8-11, with trips to Greenville, S. C., and Birmingham, Ala., on May 12, and Muscle Shoals on May 13, is the first Society meeting to be held in the South since 1916.

The industrial resources and opportunities of the South are of great import to the entire country. The coming meeting of the A.S.M.E., "the Society of Industry," will therefore have an important effect for the future, not only through the increased appreciation of the importance of recent Southern industrial development by those attending, but also in the advancement of fellowship and common knowledge and a more thorough realization of the mutual interests of the engineers of the whole country.

DEXTER S. KIMBALL.

MAY -1922

THE MONTHLY JOURNAL PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS



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Mechanical Engineering

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Contributors and Contributions

Power Development in the Southeast

CHAS. G. ADSIT

Some interesting facts on the Muscle Shoals power project are brought out by Charles G. Adsit in his paper on the unusual power resources of the Southeast. Mr. Adsit was born in Ironton, Ohio, and from his high-school days has been connected with electric-power work, his vacations being spent with the Fort Wayne Electric Co., on construction and station operation. In 1892 he was with the firm of Ball and Allen and studied under the direction of the late John R. Allen, afterward taking certain courses under him when he became a professor at the University of Chicago. In 1897–8 he was in Alaska in connection with mining work, returning to Chicago to become construction engineer with Rockwell and Snyder. From there he went to the Test Department of the General Electric Co. at Schenectady, N. Y.

Positions in charge of hydroelectric and steam power developments which he held later at four different mines in the West were followed by some research work in Detroit, Mich. In 1912 he became interested in the power possibilities of the Southeast, and as chief engineer took charge of the Tallulah Falls, Ga., 90,000-hp. hydroelectric development of the Georgia Railway and Power Co. He has been connected with the power projects of this locality ever since and is at present executive engineer and one of the directors for the Georgia Railway and Power Co., at Atlanta. Mr. Adsit is a Fellow of the A.I.E.E. and Vice-President of its Southeastern Division.

Power-Plant Boiler-Room Performance and Practice

A very interesting paper on what has been accomplished at the Colfax Station power plant of the Duquesne Light Company is presented by Charles W. E. Clarke in this issue. Mr. Clarke has been associated with the Dwight P. Robinson Company since 1919 and had had much experience with power installations previous to that time. His early associations were in Chicago where he designed several power and refrigerating plants for Armour and Company. Later, as chief draftsman for Sargent and Lundy, the design specifications and construction work for installations aggregating 100,000 kw. in the Chicago district were completed under his direction. In 1907 he became associated with the New York Central Lines and was in charge of mechanical engineering in the New York electrical zone until 1910. Between that time and his joining the Dwight P. Robinson Company he was with Stone and Webster, in charge of a large number of power developments.

The Value of Clean Blast-Furnace Gas

The latest methods of electrically cleaning blast-furnace gas are taken up in this paper by N. H. Gellert. Born at Baltimore, Md., Mr. Gellert took his A.B. at Yale in 1910 and subsequently obtained degrees of Ph.B. and C.E. at the same university. He has been assistant chief engineer in charge of construction of gas plant and property for the Key West Gas Company at Key West, Fla., and chief engineer in charge of design and construction for the Porto Rico Gas Company at San Juan, P. R.

Since that time he has been consulting engineer for gas companies, industrial gas-system manufacturers, and for companies operating blast furnaces He designed and built the first two commercial Cottrell blast-furnace gas cleaners in the world and has written several papers on the electrical cleaning of blast-furnace gas. He is at present president of the Gellert Engineering Company, of Philadelphia, consulting engineers.

Shop Practice in Building Revolving Flat Cards

In this paper on the manufacture of machines for the cleaning of cotton fibers, Frederic E. Banfield, Jr., describes in detail the really remarkable degree to which automatic machinery for their production has been developed.

Mr. Banfield is in a position to speak authoritatively on his subject as he had a thorough grounding at the Massachusetts Institute of Technology and Brown University, and since 1908 has been with the Saco-Lowell Shops, manufacturers of textile machinery. He started with this organization in the foundry, subsequently had experience in the machine shop and the erecting and drafting departments, and was later made assistant superintendent and finally superintendent. He has been responsible for the design of a number of special lathes and other machinery which have greatly increased economy in the manufacture of revolving flat cards.

The Southern Worker—His History and Character

In this paper, to be presented at the Spring Meeting of the A.S.M.E. at Atlanta, Frank H. Neely has given some very valuable sidelights on the psychological make-up of the worker in the South and enough history of the industrial development in that section to explain it.

There have been excellent opportunities for Mr. Neely to study the southern as well as the northern laborer. He was born in Augusta, Ga., and took his engineering degree at the Georgia School of Technology in 1904. He spent five years in the North with the Westinghouse Electric and Manufacturing Company, of Pittsburgh, in various capacities, and while acting as manager of the works office he resigned to enter into consulting engineering practice in Atlanta. He has had several affiliations since locating in the South and is at present associated with the Fulton Bag and Cotton Mills.

A.S.M.E. NEWS

Since December 22, 1921, a copy of the new semi-monthly publication called A.S.M.E. NEWS has been mailed to each member of the A.S.M.E. Are you reading your copy carefully? If not, you are missing an interesting means of following the many and important activities of the Society.

#MECHANICAL ENGINEERING

Volume 44 May, 1922 Number 5

Power Development in the Southeast

Utilized and Undeveloped Water-Power Resources of Five Southern States Discussed—Present State of Muscle Shoals Project and Future Possibilities Described

By CHAS. G. ADSIT,[1] ATLANTA, GA.

In considering the power development in the Southeast, it is perhaps in order to give a brief history of the development and use of hydroelectric power since this form of energy predominates in this section.

It has been found that some form of water wheel was in use with primitive peoples as far back as any record is available, the first ones raising water for irrigation and for grinding grain. Water wheels have gone slowly through the various steps of development from these early times, but it was not until their application to driving electric generators that improvement of design and efficiency began. Since that time, they have grown from a few horsepower to 50,000-hp. units. The serious construction involved in the application to hydroelectric power, began in the early 90's, but developments which in former years were too far from the center of application for the power to be transmitted, since the location of hydroelectric possibilities are not usually in sections which lend themselves to a large growth of population.

As the use of electric power became more and more general, and was not confined merely to lighting, the improvement and increase in size of generators became rapid, and the ease with which electric current could be applied to lighting and power purposes, made its application imperative throughout a very wide field, at present embracing some 3000 distinct uses.

It has been said that the growth of any community—large or small—depends largely on two factors, transportation and available power. It is therefore of the greatest benefit to any community

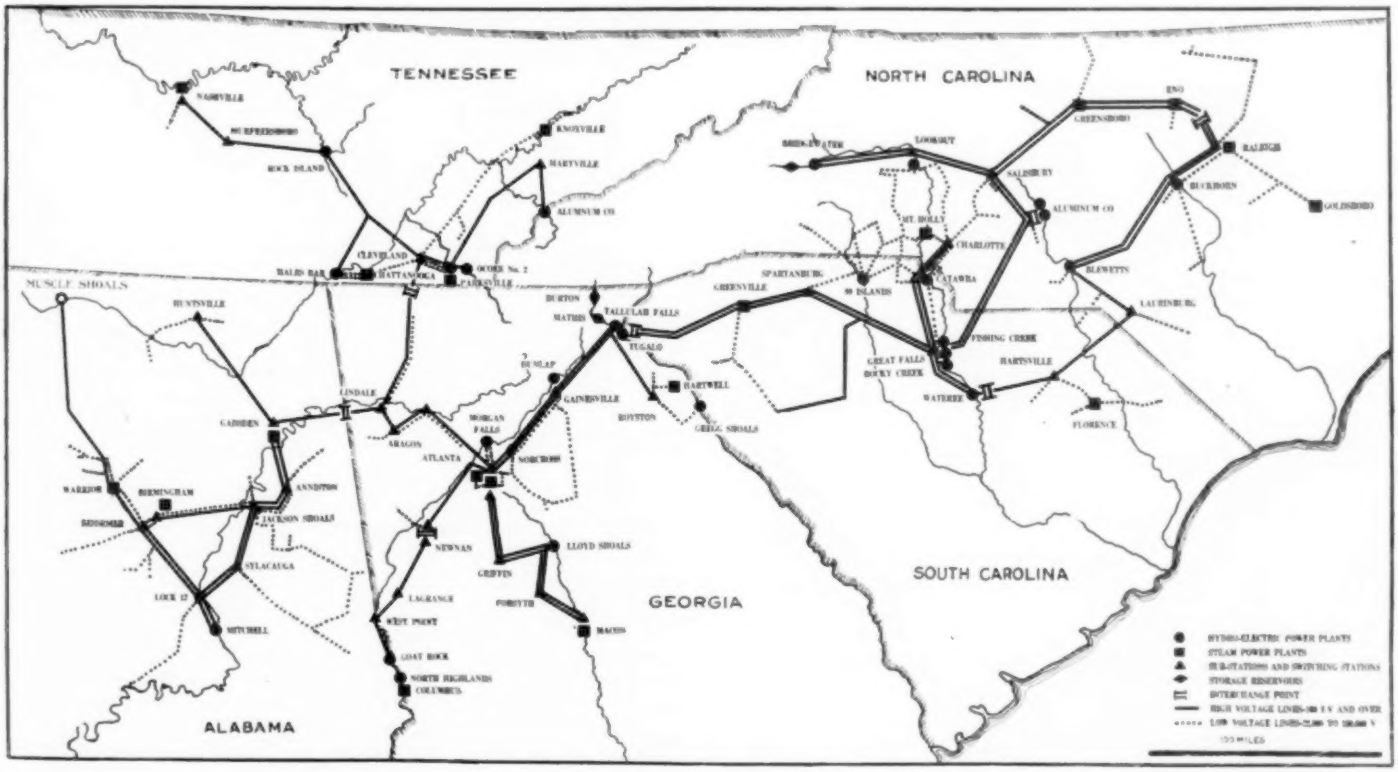

Fig. 1 Five-State Transmission System

at that time its use was still restricted by the limitation of transmission. In 1897, the highest voltage of transmission was 20,000; in 1900 this had grown to 40,000; in 1903, to 60,000; in 1908 to 100,000; in 1913 to 150,000; and today there are two lines being built in California whose operating voltage will be 220,000. One of these lines is approximately 250 miles long, the other something more than 300 miles.

The increase in voltage has made available many hydroelectric

to do everything possible to promote power developments and to show its public utility companies the greatest consideration.

Power Resources of the Southeast

The southeastern section is traversed by the great Appalachian Mountain Range, which rises to an altitude of from one to seven thousand feet above sea level, and enjoys an average annual precipitation greater than that of any section of the United States, the average ranging from 50 in. to 85 in. per annum. In the foothills of this mountain range are many streams and rivers which have a fall, as a rule, too great for them to be navigable and so lend

[1] Director and Executive Engineer, Georgia Railway & Power Co.

For presentation at the Spring Meeting, Atlanta, Ga., May 8 to 11, 1922, of The American Society of Mechanical Engineers. Copies may be obtained gratis upon request. All papers are subject to revision.

themselves admirably to economical development. This region also enjoys a climate of even temperature not subject to severe winters or ice conditions. The mean annual temperature varies from 55 deg. at an elevation of 2000 ft. above sea level to about 60 deg. at 500 ft. elevation.

The region is somewhat heavily timbered, especially on the head waters of the streams, and this to a large extent prevents a sudden run-off or great floods except during periods of extraordinary precipitation.

Five-State Development

It is intended to deal herein largely with the water-power and steam-generating stations that are now connected to the transmission system covering the five states of Alabama, Tennessee, Georgia, and North and South Carolina. The transmission system as shown in the accompanying map, Fig. 1, includes the five states mentioned, forming a trunk line some 900 miles long with several thousand miles of main line connected. It is operated at 110,000 volts, 3-phase, and at 60-cycle frequency. All of the large water-power and steam-generating stations in this territory are connected to this transmission system, making it possible to transfer power from one locality to another. This relieves power shortages due to periods of drought at water-power stations, or shortage of coal at steam plants or any other unforeseen circumstances which may interfere with the power supply in the different sections. In several instances, every power station connected to this system has been operated in parallel at the same time and with marked success. During the month of October, 1921, a part of Georgia and a part of North Carolina suffered a severe shortage in water due largely to the fact that the precipitation for the preceding six months was considerably below normal, but by means of the existing transmission system, both the affected areas were fully supplied with power from other parts of the system. Had this great transmission system not been in service, and interconnected, the industrial load in these two localities would have been necessarily dropped, since the power companies could not have supplied a larger amount of power than that required by the municipalities which they also serve. However, the other power companies by lending their assistance prevented any shutdown whatsoever in the industrial plants and the consequent unemployment of many thousand operators.

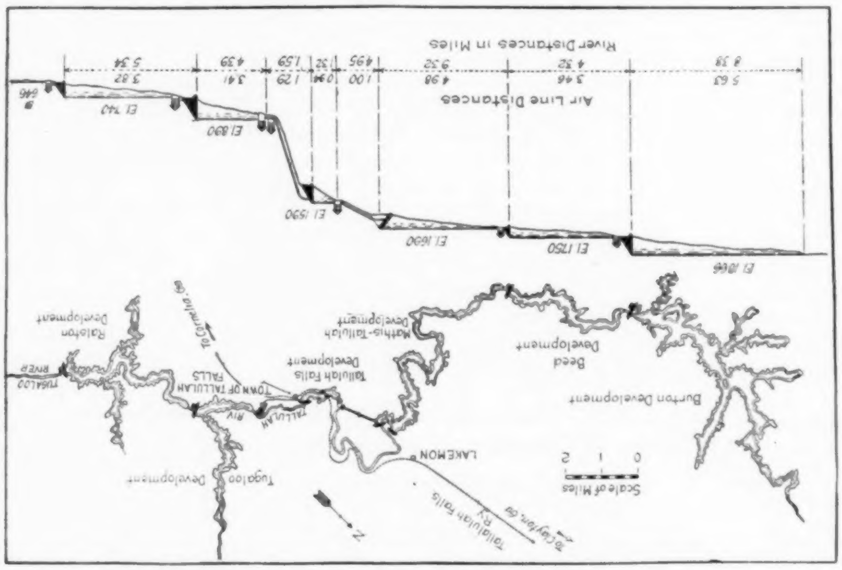

Fig. 2 Scheme for Complete Development of Tallulah River

The table under Fig. 2 gives the installed capacity of the various power developments which are connected to the system under discussion. From this table it will be noted that the total installed capacity is 1,010,355 hp. The total output of the system during 1921 was approximately two billion kilowatt-hours.

New developments are constantly being made by the various power companies comprising this system, and there is now under construction an additional 310,000 hp. capacity in generating equipment. This does not include 90,000 hp. which will also be installed as an addition to one of the new plants at a later date, nor the much-discussed Muscle Shoals hydroelectric development, mention of which will be made later.

Power-Generating Stations of the Power Companies of the Southeastern Section

Hydroelectric Stations			Steam Stations
	Alabama Power Co.		
	KW.		KW.
Lock 12	72,000	Warrior	60,000
		Gadsden	10,000
		Birmingham	10,000
	Tennessee Power Co.		
	KW.		KW.
Parksville	15,000	Parksville	6,125
Hales Bar	37,100	Nashville	15,500
Great Falls	7,800	Knoxville	6,125
Ocoee No. 2	10,500	Chattanooga	3,000
	Georgia Railway & Power Co.		
	KW.		KW.
Tallulah Falls	72,000	Atlanta No. 1	11,000
Morgan Falls	10,500	Atlanta No. 2	10,500
Dunlap	2,200		
Chestatee	1,100		
Gregg Shoals	1,200		
	Columbus Power Co.		
	KW.		KW.
Goat Rock	11,000	Columbus, Ga.	9,000
North Highlands	6,900		
	Central Georgia Power Co.		
	KW.		KW.
Lloyd Shoals	14,400	Macon Nos. 1 and 2, each	1,500
	Southern Power Co.		
	KW.		KW.
Bridgewater	20,000	Eno	10,000
Lookout	18,000	Greensboro	6,800
Catawba	4,800	Mount Holly	6,800
Fishing Creek	30,000	Greenville	6,800
Great Falls	24,000		
Rocky Creek	24,000		
Wateree	56,000		
99 Islands	18,000		
	Carolina Power & Light Co.		KW.
	KW.	Florence	1,500
Buckhorn	2,900	Raleigh	3,720
Blewetts	33,100	Goldsboro	1,200
Total kw.	492,500	Total kw.	181,070
Total hp.	738,750	Total hp.	271,605
Total developed horsepower, hydroelectric and steam			1,010,355

Water-Power Reserves

The steam generating stations of the Southeast, generally speaking, are used for the purpose of supplementing the water-power production. Many of the water-power plants are, however, also backed by large storage reservoirs, making their annual output practically continuous regardless of dry months or dry years. On the head waters of the Catawba River, the Southern Power Company has constructed a very large storage reservoir at Bridgewater, N. C., which has a capacity of 13,500,000,000 cu. ft., representing 90,000,000 kw-hr. under present conditions at the various water-power plants already constructed below. The Georgia Railway & Power Company has two storage reservoirs on the Tallulah River, one at Burton containing 5,280,000,000 cu. ft. and one at Mathis containing 1,369,000,000 cu. ft. This total storage on the Tallulah River represents approximately 70,000,000 kw-hr. at the present developments and makes available for use in power production at the plants below, about 95 per cent of the annual stream flow. This storage will later be equivalent to 125,000,000 kw-hr., when other developments contemplated and under construction are completed.

The diagrams given in Fig. 2 show the scheme for the complete development of the Tallulah River with reservoirs and power plants. These developments when completed will have an average annual output of 535,000,000 kw-hr., the reservoir capacity falling through 1220 ft. head. In this section the average annual precipitation is about 65 in., and the average annual run-off about 40 in.

The entire section of the Southeast is fortunate in having water power available which can be depended upon so completely due to the fact that great droughts seldom occur. There is no section of the United States with the exception of that adjacent to Niagara Falls, or in sections where the streams are fed from perpetual snows, where the flow of the streams and rivers can be so thoroughly depended upon. This insures a continuous supply of power to the various industries located in this section, with very little secondary power available or desired.

It may be interesting in passing to note that the power connected to the transmission system under discussion represents 17.75 per cent of the total water-power development in the United States.

Undeveloped Resources

While the Southeast has enjoyed extensive hydroelectric development already, it still has many sources of potential water power available for development as rapidly as the demand for electric power increases, and it will be many years before the entire possibilities of the streams in this section are exhausted. There are many industries not supplied at present with hydroelectric power which are depending upon the cheapness of fuel in the section where they are operating, and which in time will turn to electrical energy for their power needs. The electrification of the railroads of the South, which cannot be put off for many more years, will also provide an outlet for a large block of electric power, many of the trunk trail lines being already paralleled by transmission lines of sufficient capacity to meet their requirements.

It has been found in communities where electric power is available and generally used, that the consumption amounts to approximately 500 kw-hr. per inhabitant per annum. As stated above, the total output per year of the various power companies connected to the system under discussion now amounts to 2,000,000,000 kw-hr. while the population of the territory served by this system is approximately 11,819,585, showing that there is only 34 per cent saturation in this territory, based on the consumption of electric power in communities where it is in more general use.

Muscle Shoals Conditions

Anything that is said or written about the power developments in the Southeast cannot pass without some reference to the Muscle Shoals hydroelectric development, especially that part of this development known as the Wilson Dam or Dam No. 2.

The Muscle Shoals section of the Tennessee River is the name applied to the fifty-mile stretch between the railroad bridge south of Florence, Ala., and Brown's Island, near Decatur, Ala., which is not now navigable during periods of low water comprising approximately six months of each year. The Shoals are located approximately 150 miles southwest of Chattanooga, Tenn., and are about 125 miles northwest of Birmingham, and a similar distance from Memphis, Tenn. They are about 200 miles in an air line from Atlanta.

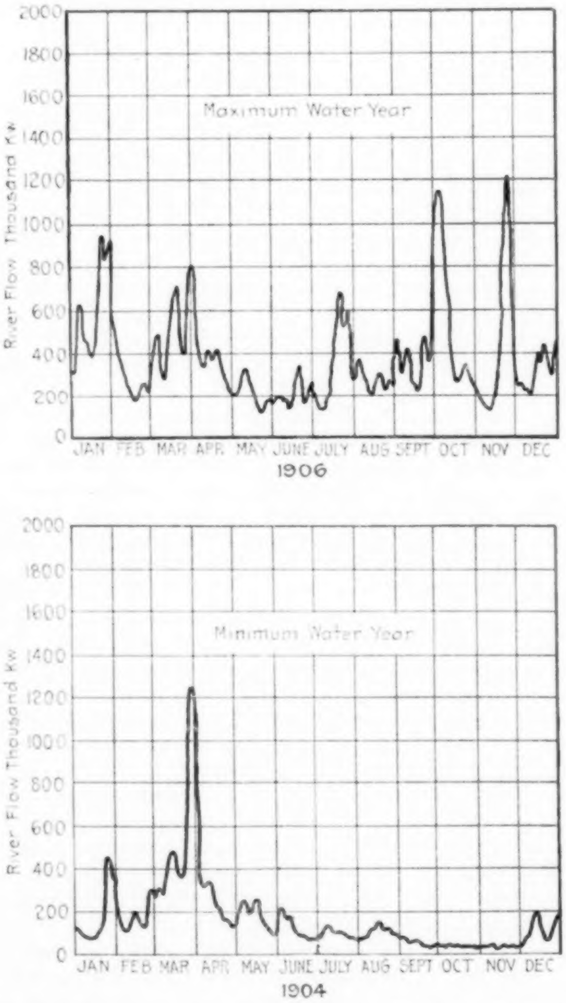

Fig. 3 Hydrographs of the Tennessee River at Florence, Ala., for 1904 and 1906

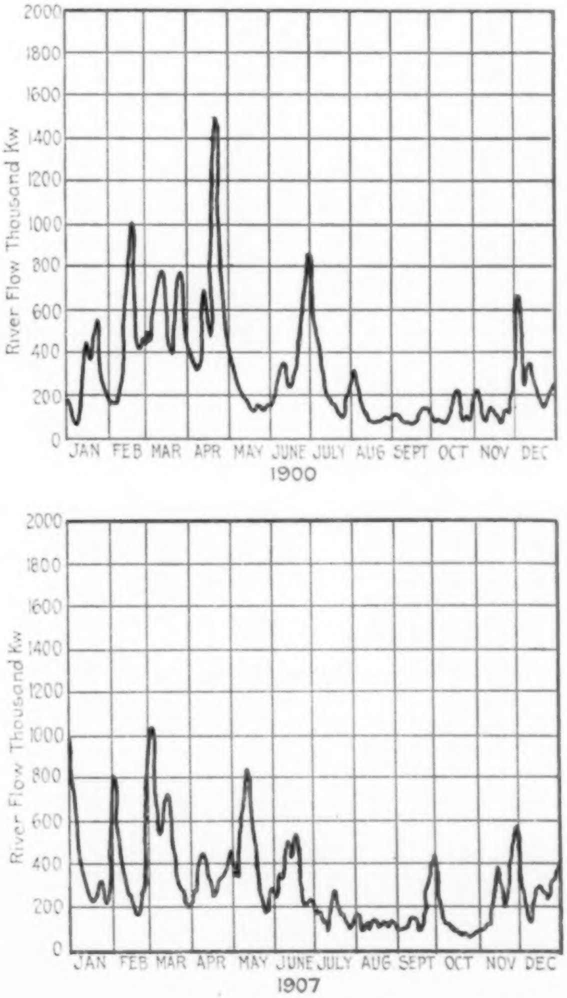

Fig. 4 Hydrographs of the Tennessee River at Florence, Ala., for 1900 and 1907

Sometime prior to 1890 the effort of various individuals and organizations to do something with Muscle Shoals was begun, and the matter has been more or less active ever since that time. Every effort until recently has been in the nature of forcing the Federal Government to develop Muscle Shoals for the ostensible purpose of improving the navigation of the Tennessee River, on which very little navigation has ever existed, with the secondary object of producing hydroelectric power.

In the year 1890 a canal was cut around the Shoals by the Federal Government for the purpose of improving the navigation at this point, and this constituted the first step in the Government's activities at this location. Since that time, various bills have been introduced in Congress for the continued improvement of the river, but all plans have carried with them the idea of developing the hydroelectric power.

As soon as it became apparent that the United States would be ultimately drawn into the European war, it was brought to the attention of the Government that an interference with the supply of Chilean nitrates (sodium nitrate, $NaNO_3$) would seriously cripple the ability of the United States to supply ammunition for itself and associated nations in the war. So a clause was inserted in the National Defense Act of 1917, which appropriated twenty million dollars for the purpose of investigating the advisability of, and taking the necessary preliminary steps toward, the erection of a plant for the fixation of atmospheric nitrogen, the idea being that such a plant should be erected at or near some water-power site, remote from the sea coast, where the large amount of electric power required by the process would be cheaply available. The

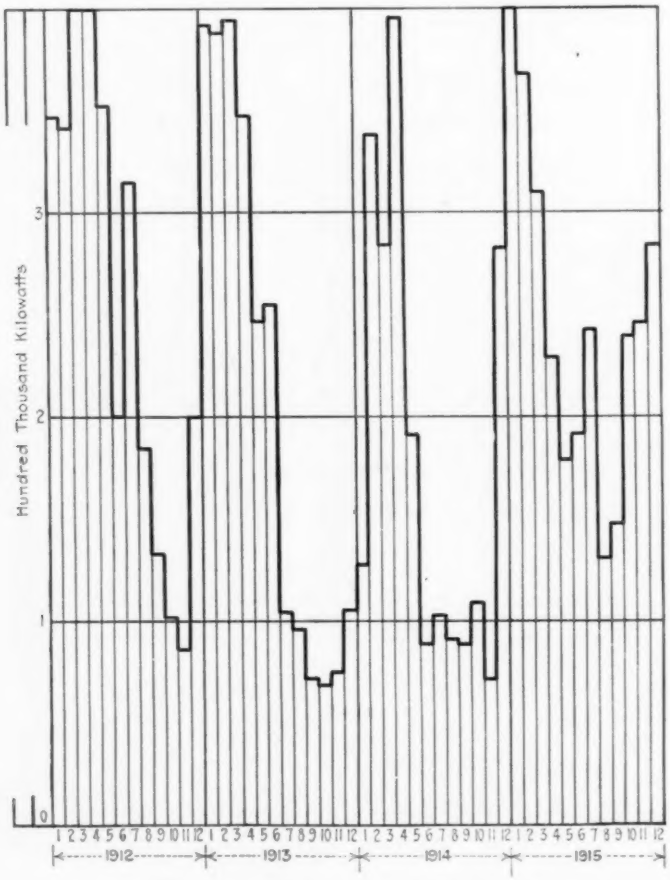

Fig. 5 Powergraph of Tennessee River from 1912 to 1915

authority for this investigation and action was vested in the President, and he in turn selected a committee to carry out the intention of the Act.

Present Development

An early investigation of the water-power situation at Muscle Shoals indicated that the hydroelectric power plant could not be built in time for service during the war in connection with the nitrate plant, and as a consequence a steam plant was constructed at Nitrate Plant No. 2, with a capacity of 60,000 kw. in one three-part turbo-generator unit, room being provided in the plant for the later installation of a second unit of 30,000 kw. It is a modern, up-to-date plant, well designed and thoroughly efficient. The construction of this plant was carried out by the Government and cost approximately thirteen million dollars.

In addition, a steam unit of 30,000 kw. capacity was installed by the Government at the Warrior River steam plant of the Alabama Power Company, 90 miles from Sheffield, Ala., and connected with the nitrate plant by a 110,000-volt transmission line, the total cost of this improvement being approximately five million dollars. Also, a limestone quarry was purchased and opened at Waco, Ala., for the purpose of supplying the nitrate plant with the lime necessary in the production of calcium carbide.

To get back to the subject of the Muscle Shoals hydroelectric development: It was decided early in 1918 to call the dam the Wilson Dam, since the decision as to its construction was originally vested in President Wilson and it was he who directed that the project be carried out. At the time it was decided to proceed with the development, the property was more or less completely in the hands of the Muscle Shoals Hydroelectric Power Company. This company did not desire to stand in the way of any improvement which would further the prosecution of the war, and therefor surrendered all of its holdings, including dam sites, water right and plans to the Government for "one dollar and other considerations." As a consequence of these earlier negotiations, actual construction work on the project was begun during the spring of 1918.

The plans call for a dam about 100 ft. high and almost one mile in length, and include two locks for navigation requirements on the northern end of the dam with two 50-ft. lifts, said to be the highest-lift locks anywhere now contemplated. The dam is to be fitted with crest gates 18 ft. high for flood control, the gates to be counterweighted and operated by electric motors. The dam is to be of liberal gravity section, and will be constructed with a downstream apron which extends approximately 100 ft. below the toe of the dam, to protect the river bottom from the overfall. There is to be a highway bridge across the top of the dam above the gates. The dam will contain 1,250,000 cu. yd. of concrete. The power house is to be constructed on the southern end of the structure and built integral with the dam. It will contain a total of eighteen units, four of which have already been contracted for and built. They will be of the usual vertical type with 30,000-hp. water wheels, directly connected to 22,500-kw. generators, together with all the usual auxiliary equipment. It is now contemplated that the fourteen remaining units will be built with 36,000-hp. water wheels, and 27,500-kw. generators, making the total capacity of the plant in generating equipment approximately 400,000 kw. The power house is being constructed at this time for the full ultimate installation.

The Government has prosecuted this work somewhat intermittently since it was started, and has completed, up to the present time, a four-track bridge below the dam across the river for construction purposes, and the excavation for the power house. Two hundred and fifty thousand cubic yards of concrete have been laid in the dam structure on the north end, a portion of the excavation for the locks has been completed, and about 60 per cent of the excavation for the dam, of which there is a total of 620,000 cu. yd.

All of the work done on this project to date has cost approximately seventeen million dollars, and estimates covering the work necessary to complete the project vary from twenty to thirty-five million dollars. The work today is about 20 per cent complete and has been entirely shut down for more than a year.

Much has been said from time to time about the foundations at this dam site. A thorough investigation has been made by both diamond drills and well drills, and the records of these operations indicate that the foundations under the main part of the dam are satisfactory. There is, however, a seam appearing in the southern abutment which extends for a long distance into the surrounding country, and this is now being investigated by tunneling to see if it is or can be made watertight.

Possibilities

Volumes have been written in the Government records and in the press regarding the hydroelectric-power possibilities of Muscle Shoals. It is distinctly a run-of-river proposition, as no storage is created by the dam except that required to control the daily flow of the river. The Government at the present time has a requirement in existence for the benefit of navigation below, which will not allow the control of river flow under 10,000 cu. ft. per sec.

(Continued on page 300)

Boiler-Room Performance and Practice of the Colfax Station, Duquesne Light Company

By C. W. E. Clarke,[1] New York, N. Y.

It is the purpose of this paper to describe in some detail the operation of the boiler plant in the Colfax Station of the Duquesne Light Co., located at Cheswick, Pa. Fig. 1 is a cross-section of the boiler house and part of the turbine room of this plant. The Colfax Station at present contains one three-element-compound Westinghouse turbine of 60,000 kw. capacity and an additional similar machine will be installed this summer. The present plans for this station contemplate an ultimate capacity of 360,000 kw. The boiler plant contains seven boilers, 18 tubes high by 51 wide, each containing 20,867 sq. ft. of heating surface; and four additional boilers, 20 tubes high by 51 wide, each containing 22,914 sq. ft. of heating surface, are being installed this summer. The station is designed for base-load operation. Under present conditions it is possible to maintain a load in excess of 50,000 kw. for most of the day. For the night periods, from about midnight until seven or eight in the morning, the load may fall as low as 30,000 kw.

The boiler room was designed with a view to securing the highest ultimate efficiency in point of fuel, labor and fixed charges. It will be noted that the labor per horsepower is very small. The area covered by the boiler house per boiler horsepower is only 1.37 sq. ft.

Fuel and Fuel Handling

Coal is brought to the station on a standard-gage railway in 50-ton hopper-bottom cars from the Harwick Mine, which is owned by the Duquesne Light Company and located about a mile and a half from the power station. A space about 1000 by 400 ft. just north of the power station is provided for coal storage and is large enough for the storing of about 150,000 tons of coal. A rope-operated gantry bridge is now being erected for handling coal into and out of this storage.

At the plant, coal is dumped into receiving hoppers under the tracks. Crushers are located below the hoppers and the crushed coal is raised by two pivoted bucket elevators to distributing belt conveyors over the bunkers. As the coal goes to the crushers, water is added to help keep down the dust, and as an aid to combustion.

A representative sample of each day's coal is secured by taking individual samples of about 75 lb. from each carload as the cars are dumped. These are placed in airtight cans and so kept until they are to be used. The whole day's samples are then run through an automatic crushing and sampling machine which extracts a 3 to 4 per cent sample, amounting at the present time to about 40 lb. This 40-lb. sample is quartered on a clean floor and two 3-lb. samples are taken out and put in sealed containers. One of these is sent to the laboratory for analysis and the other is held at the plant until satisfactory analysis of the laboratory sample has been completed.

To secure samples of the coal as fired, a sample of about 1000 lb. is also taken from the stoker hoppers at 7 a.m. daily. This sample is treated in the manner described above. Table 1 shows the average of a number of proximate analyses of the fuel and Table 2 a representative ultimate analysis.

The coal bunker is of reinforced concrete and has a capacity of about 240 tons per boiler. Coal is not permitted to remain in the bunker longer than about three days, which practically eliminates any possibility of spontaneous combustion in the bunkers. Distribution of the fuel to the individual stoker hoppers is by means of two weighing larries each having a capacity of 10 tons. A number of openings in the bottom of the bunker are provided with short cast-iron spouts equipped with chain-operated gates and permit coal to be taken from any part of the bunker.

Stokers and Clinker Grinders

Each stoker is provided with an extension hopper, the capacity of the grate and hopper together being about 25,000 lb. The stokers are of the Westinghouse underfeed type and have 17 retorts of 20 tuyeres each. The projected grate area of each stoker is approximately 403 sq. ft.

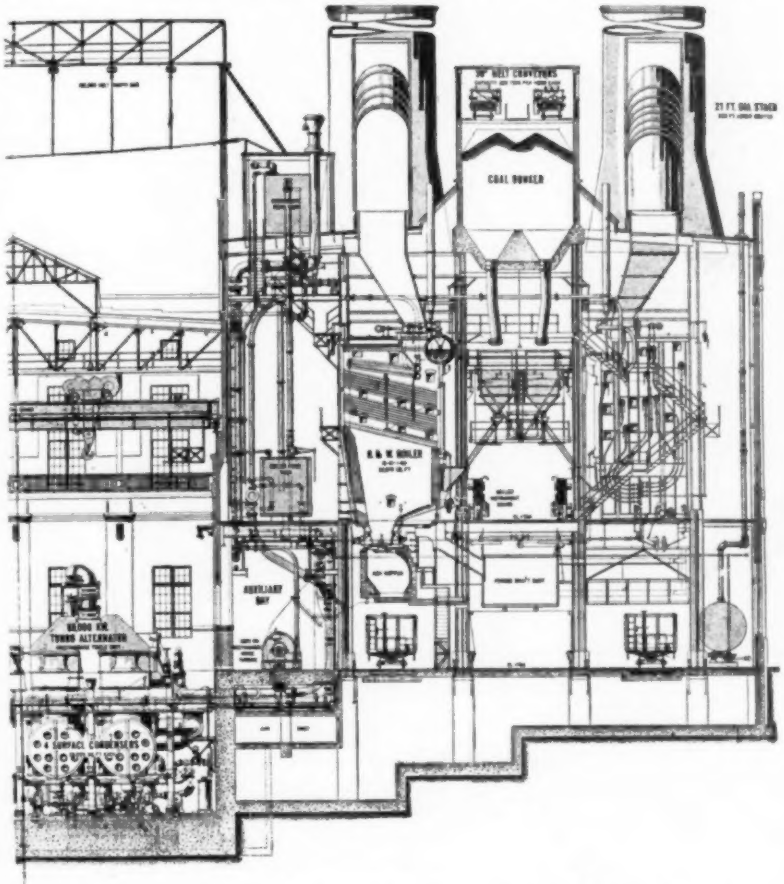

Fig. 1 Cross-Section of Boiler House and Part of Turbine Room

TABLE 1 PROXIMATE COAL ANALYSES

	As Received		Moisture-Free	
	As Unloaded	As Fired	As Unloaded	As Fired
No. of samples	25	30	25	30
Moisture, per cent	2.9	4.1	...	...
Volatile matter, per cent	34.5	34.1	35.5	35.6
Fixed carbon, per cent	53.0	52.5	54.6	54.8
Ash, per cent	9.6	9.3	9.9	9.6
Total, per cent	100.0	100.0	100.0	100.0
Sulphur, per cent	1.0	1.1	1.1	1.2
Calorific value, B.t.u. per lb.	13,351	13,237	13,758	13,895

The difference in moisture between the coal as unloaded and as fired is due to the addition of water at the crushers mentioned above.

TABLE 2 REPRESENTATIVE ULTIMATE ANALYSIS OF FUEL

	As Received	Dry Coal	Moisture-and Ash-Free
Ash, per cent	8.88	9.30	.....
Sulphur, per cent	1.09	1.14	1.26
Carbon, per cent	72.92	76.40	84.23
Hydrogen, per cent	5.39	5.12	5.64
Nitrogen, per cent	1.49	1.56	1.72
Oxygen, per cent	10.23	6.48	7.15
Total, per cent	100.00	100.00	100.00
B.t.u. per lb. by calorimeter	13,202	13,832	15,251
B.t.u. per lb. by analysis	13,199	13,828	15,246

[1] Dwight P. Robinson & Co. Mem. Am.Soc.M.E.

Abstract of a paper to be presented at the Spring Meeting, Atlanta, Ga., May 8 to 11, 1922, of The American Society of Mechanical Engineers, 29 West 39th Street, New York. All papers are subject to revision.

Each stoker is driven by a 15-hp. variable-speed direct-current motor, equipped with both armature and field control. Current for these motors and for the clinker-grinder motors is supplied by two 2200-kw. 440-volt a.c. to 125-volt d.c. motor-generator sets located in the auxiliary bay of the turbine room.

The stoker operator is guided entirely by observation of the fires and of the wind-box pressure. The forced-draft-fan speed and consequent wind-box pressure are automatically controlled by variations of the steam pressure in the main header. Wind-box pressure is for this reason somewhat of an indication of load condition. The pressure over the fire is maintained at from 0

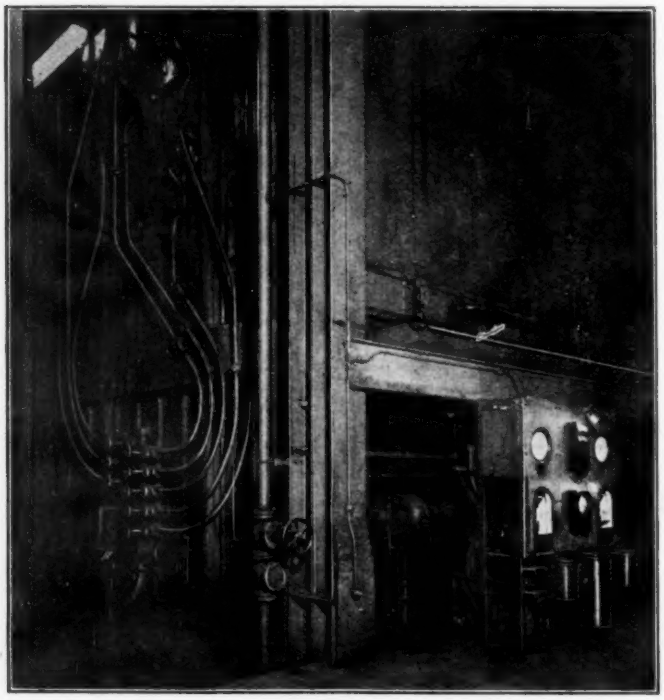

Fig. 2 General View of Boiler

to minus 0.1 in. of water by means of balanced-draft damper controllers.

In this type of stoker the upper and lower rams are linked together, but the movement of the lower rams is made much less than that of the upper through lost motion in the linkage. In case the fire piles up on the lower end of the grate this lost motion may be taken out by means of U-links which are left on until the fire is in proper condition. The stoker drive is capable of very close speed regulation and with ordinary care and the occasional use of the U-links, an even fuel bed suitable to the load may be maintained.

Each boiler is provided with an individual instrument and control board shown at the right in Fig. 2. At the top are two pressure gages connected to either end of the boiler drum. Between them is a three-in-one draft gage which indicates the pressure in the wind box, over the fire, and in the boiler uptake. Below the draft gage is a combined CO_2 and furnace-pressure recorder. Each of the two boiler-feed lines is provided with a Simplex venturi meter, the recorders for which are at the bottoms of the two side panels. Each of these meters has a capacity sufficient to feed the boiler at over 250 per cent of rating. The stoker and clinker-grinder motor controllers are bolted to the frame below the board, with the stoker-motor controller in the center and the clinker-grinder controllers at either side. This places practically the entire control for each boiler at one point so that but one stoker operator is required for 4175 nominal boiler horsepower, which is over 9000 developed boiler horsepower at 220 per cent rating, the normal daytime condition. No centralized control is provided as such a system is of doubtful advantage. The management of stokers, aside from that which can be made automatic, must be almost entirely through visual observation of the fuel bed. There are few factors of stoker control that can be centralized in such a way as to save either labor or fuel. Fig. 2 shows the general arrangement of the boiler, gage board, etc.

When this installation was first put in operation some difficulty was encountered with clinkering. After considerable experimenting it was definitely determined that this was due in part to periods when there was pressure over the fires and in part to improper water distribution in the clinker pits. Particular care is now taken to maintain a furnace pressure below atmosphere at all times, and the water distribution has been improved as described below with the result that clinker trouble has been practically eliminated.

Some trouble was at first experienced due to burning out of the lower front-feed wedges. This trouble has been largely eliminated by allowing air to blow through from the wind box, thus keeping the wedges cool. To facilitate replacement, the air-box tops and

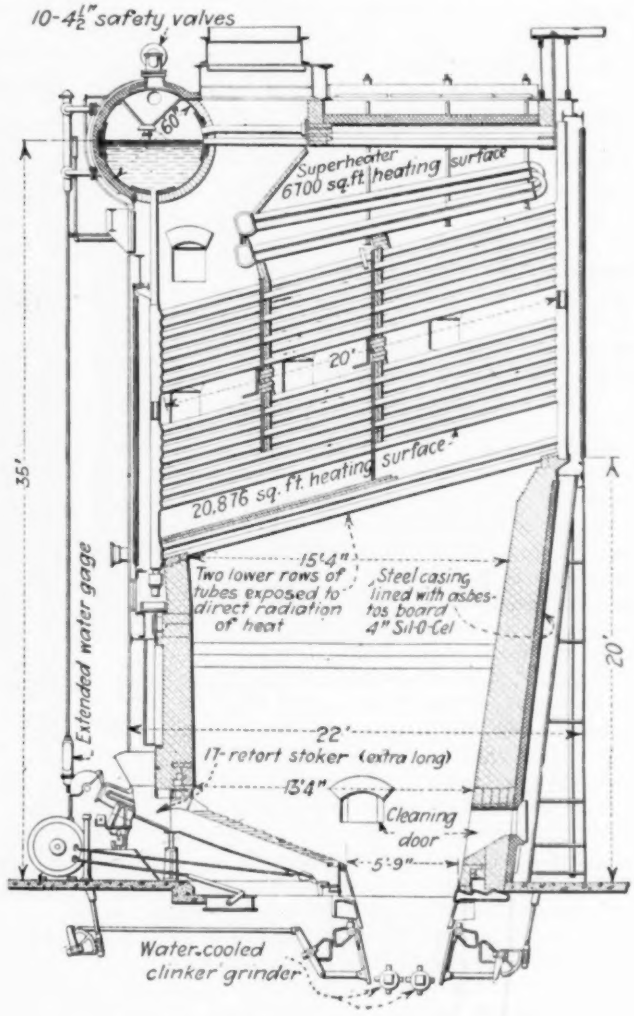

Fig. 3 Cross-Section of Boiler and Setting

grinder-pit aprons have been made sectional instead of as in the original design.

The stokers are provided with double-roll clinker grinders, divided in the center, with the rolls turning toward each other. The two halves are driven by separate motors, separately regulated, giving individual control over the two halves of the grinder. The rolls are driven through reciprocating pawls and ratchets which may be disengaged on either roll. It has not been found desirable to operate the rolls continuously. Under normal operating conditions the rear rolls are operated rarely, the front rolls being run for periods of from two to five minutes in every twenty minutes, which means from six to eight revolutions in one hour. Grinder operation is governed entirely by observation of the ashpit. The top of the ash bed is kept above the top of the rear wall air boxes.

To prevent the formation of clinker masses in the ashpit and to cool the clinker rolls, water is introduced above the rolls. Upper-grate box tops having a down-turned projecting lip are installed,

under which lip is placed a horizontal spray pipe perforated with quarter-inch holes six inches apart. This pipe introduces the water high up in the ashpit and quite effectually prevents the formation of hard clinker masses. The introduction of water high up in the ashpit tends to quench the ash before combustion is as complete as could be desired, thus increasing the amount of combustible in the ash. At the present time this seems to be the lesser of two evils. The sprinkling system requires about fifty gallons per minute for each boiler.

Ash Handling and Sampling

The clinker grinders discharge into firebrick-lined reinforced-concrete ash hoppers with an approximate capacity of 60 cu. yd. These hoppers will hold the refuse of from one and a half to two days' normal operation. It is the regular practice, however, to remove the refuse from all working boilers twice a day.

A sample of ash from each boiler is taken every other day. A gross quantity of about 400 lb. is taken from the total 24-hr. dump from each boiler, the sample being taken from six different points in the pile, at a depth of about three feet below the surface of the pile. The whole sample is then hand-crushed and quartered until about three pounds remain, which is sealed in a container and sent to the laboratory to be analyzed for combustible. The method of analysis is in accordance with the specifications of the American Society for Testing Materials.

Boilers

There are at present seven boilers of the Babcock & Wilcox cross-drum type, 18 tubes high by 51 wide, with 20,876 sq. ft. of heating surface and with the so-called "Alert" baffling. There are 918 tubes in each boiler proper and 102 circulating tubes connecting the uptake headers with the drum, making 1020 tubes in all. Fig. 3 is a cross-section of the boiler and setting. It will be noted that the combustion space is large. The present settings contain 0.345 cu. ft. of combustion space per square foot of heating surface and those to be installed this summer will be the same.

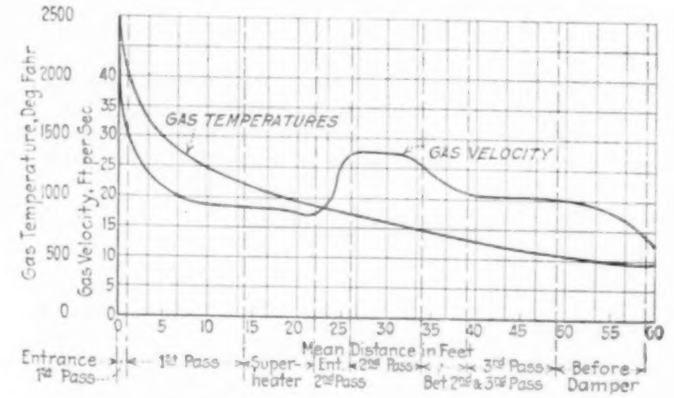

Fig. 4 Variation of Temperature and Velocity of Flue Gas Throughout the Boiler

Each boiler has two water columns with high- and low-water alarm whistles. When one of these alarms sounds the operator examines the feed regulators for possible sticking, and if necessary cuts it out and uses hand control until repairs can be made. If the regulator is found to be all right he checks up the feed pressure and if necessary starts another pump or puts on the auxiliary feed.

Furnace temperatures vary from 2500 to 2800 deg. fahr.; at the top of the first pass this approximates 1000 deg. fahr., between the second and third passes it is 530 deg. fahr., and the exit gas temperature varies from 450 to 480, usually being about 470 deg. fahr. Fig. 4 is a chart showing the temperature range and gas velocities through the boiler. Typical temperature and CO_2 traverses are given in tabular form in the complete paper.

Slagging on the boiler tubes is slight and has never been sufficient to cause trouble. The use of distilled make-up water eliminates trouble from scale and consequent tube renewals. The total commercial operation of the seven boilers now installed has been approximately 39,922 boiler-hours up to February 1, an average of 5703 hr. per boiler and but two tubes have been replaced.

Each boiler is equipped with eighteen soot-blower elements, nine on each side. These soot blowers are operated three times a day with the dampers opened wide.

In the past boilers have been taken off for cleaning and repairs after 30 to 45 days of service, but it is expected that in the future service periods will be from 90 to 100 days. This increase is due to some slight modification of the settings and increased knowledge of the performance of the equipment. The work of inspection and repair ordinarily takes from 10 to 14 days. Full efficiency

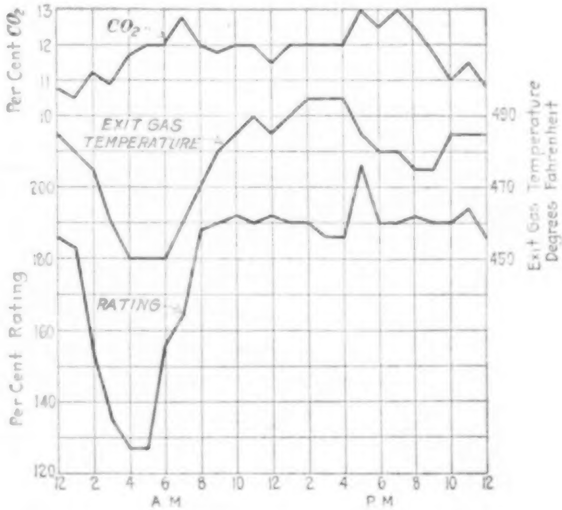

Fig. 5 Hourly Variation in Rating, Gas Temperature and CO_2 for Typical 24-Hr. Day

is not reached until from four to seven days after the boiler is put on the line.

The settings are of firebrick throughout, the brick walls being 18 in. thick. Sil-O-Cel and asbestos millboard fill the $4^1/_4$-in. space between the firebrick and the steel casing. Deterioration of the setting is very slight.

The formation of clinker on the furnace walls is prevented by air cooling, Bernitz and Drake blocks being used. These blocks did not altogether prevent clinkering on the side walls and side-wall tuyeres have been installed, which have practically eliminated it.

The superheaters are located over the tube banks between the first and second pass. Considerable trouble has been experienced because of insufficient superheat. The normal superheat should be 180 deg., but 145 deg. has seldom been exceeded. The boilers to be installed this summer will have the superheaters located above the sixth row of tubes, and with this arrangement no trouble from deficient superheat is anticipated.

There is one forced-draft fan for every four boilers. The fans are of the radial-flow type, and have a capacity of 250,000 cu. ft. of free air per minute at a maximum static pressure of 6 in. of water. The fans are driven through reduction gears by 420-hp. turbines. Each fan turbine is provided with a speed controller actuated by variations of steam pressure in the main header. Ordinarily no control of the stoker air other than that provided by the automatic, forced-draft-fan speed control is used, although individual wind-box dampers are provided that may be used in case of emergency. There is one main forced-draft duct, 9 ft. 6 in. by 15 ft., running beneath the firing-aisle floor, from which all stokers are supplied. This duct is provided with sectionalizing dampers located midway between the fan inlets. At each boiler a branch duct runs from the main duct to the stoker wind boxes. The duct system is of $^3/_{16}$-in. sheet steel made practically airtight without welding.

The generator-cooling-air discharge is carried to the main air-supply duct from which the fans take part of their supply. In addition to this, large openings are provided at the tops of the fan chambers through which air may be drawn from the top of the auxiliary bay. In winter the openings between the fan chambers and the boiler-room basement are closed. This is done to prevent freezing of piping due to drawing large quantities of air from outdoors through the boiler-room basement.

Fig. 5 shows the hourly variation in boiler-room operation over a typical 24-hr. period. Fig. 6 shows the average efficiency, rating and gas temperature for all boilers for the period from July, 1921 to February, 1922. This clearly shows the steady increase in efficiency as conditions were improved and as the operating force became more familiar with the equipment. The low point at the beginning of December was due to a period during which there was considerable trouble with clinker.

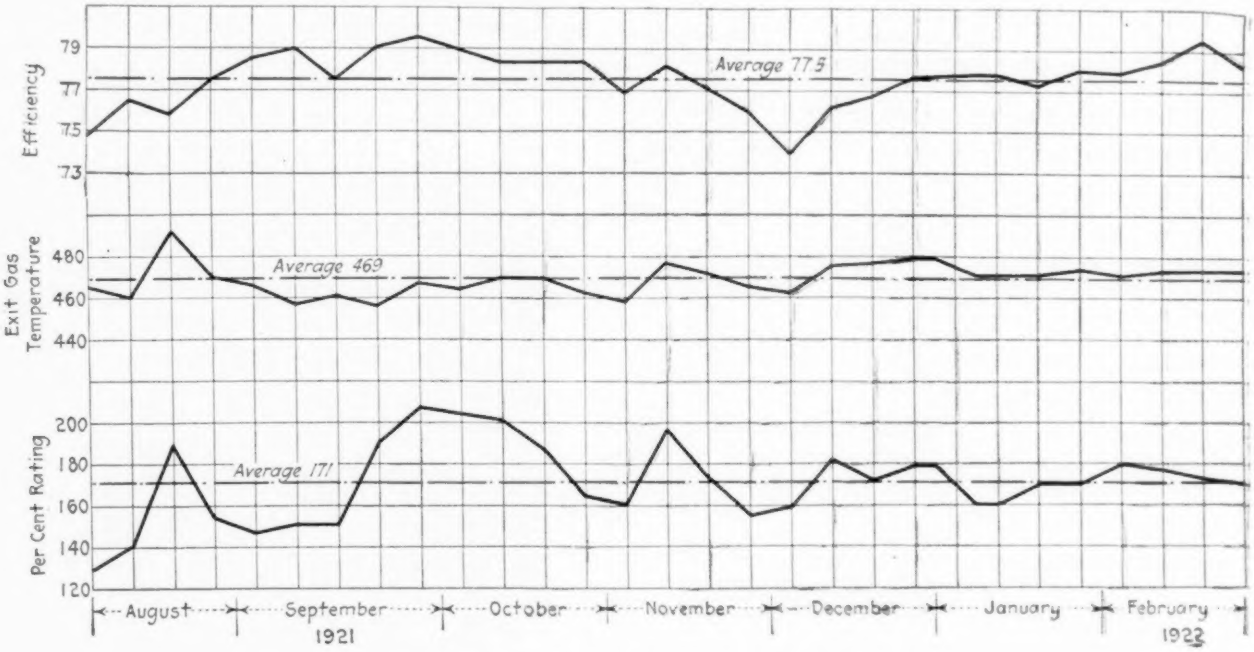

Fig. 6 Average Weekly Boiler Performance for All Boilers

Note—The points on this curve are the weighted averages of the average weekly efficiencies for the individual boilers, hence the variations at some points.

Piping System

The piping system for boiler feeding consists of a main and auxiliary header. The main header runs below the firing-aisle floor and between it and the forced-draft duct. A feed line is carried up each side of the boiler (these boilers are provided with feed connections at both ends of the drums) and is controlled by globe valves at the boiler-room floor level. Automatic boiler-feed regulators are provided on the feed lines at the boiler drums, part being Stets and part Copes regulators. The auxiliary header runs over and at the rear of the boilers. The auxiliary feed line on one side of each boiler is provided with a by-pass through the automatic controller, that on the other side being provided with hand control only. The boiler-feed system in general is described below.

The piping system was installed in accordance with the general piping specification given in the complete paper.

Feedwater System

The feedwater cycle is shown diagrammatically in Fig. 7. All water in the system is distilled. Make-up water is provided by two evaporators of the double-effect, dry-tube type. Water from the evaporators is pumped directly to the head tanks, above the barometric condensers, which serve as feedwater heaters. The average make-up required is about 1.9 per cent of the total amount flowing in the system. The tail pipe of the barometric condenser is sealed in the boiler-feed tank from which the feed pumps take their suction. Two V-notch meters are provided in this tank; one measures the water going to the feed pump and the other the overflow. All overflow from the system is piped to the boiler-feed tank so that it is recorded by this meter. Overflow from the boiler-feed tank flows to the main storage tank mentioned below. There is some variation between the water quantities recorded by the venturi and V-notch meters, but it is the venturi-meter readings which have been used as a basis for all results given in this paper.

There are three 4-stage 1500-g.p.m. turbine-driven centrifugal boiler-feed pumps, regulated to maintain a pressure in the feed system of 350 lb. per sq. in. One pump is sufficient to supply the total feedwater for a load of about 60,000 kw.

Condensate from the main unit goes first to a surface heater where its temperature is raised about 4.5 deg. fahr. by the transformer- and turbine-oil cooling water. It then goes to the evaporator condenser serving there as a circulating medium, and its temperature is increased about 32 deg. fahr. From the evaporator condenser it goes to the head tank and then through the barometric condenser. The exhaust from the house turbine and that part of the exhaust from the auxiliaries which is not used in the evapora-

TABLE 3 OBSERVATION OF DISSOLVED OXYGEN IN BOILER FEEDWATER, PARTS PER 1000 BY VOLUME

Head Tank			Boiler-Feed Tank		
Temp., Deg Fahr	Actual Dissolved Oxygen	Theoretical Dissolved Oxygen	Temp. Deg. Fahr	Actual Dissolved	Theoretical Dissolved Oxygen
100	(6) 1.93	4.7	(1) 185	1.21	1.55
101	(10) 2.10	4.65	(2) 186	1.2	1.50
102	(4) 2.15	4.6	(1) 187	1.34	1.45
103	(2) 2.05	4.55	(1) 188	1.11	1.40
104	(5) 2.43	4.5	(1) 189	0.81	1.35
105	No data	4.45	(3) 190	0.88	1.30
106	(3) 1.94	4.4	(2) 191	0.895	1.25
107	(1) 1.99	4.35	(1) 192	1.08	1.20
Mean 102	(32) 2.11	4.6	(0) 193		1.15
			(5) 194	0.75	1.00
			(8) 195	0.65	1.06
			(3) 196	0.70	0.95
			(0) 197		0.90
			(3) 198	0.506	0.85
			(0) 199		0.80
			(2) 200	0.43	0.75
			(0) 201		0.70
			(0) 202		0.60
			(0) 203		0.55
			(1) 204	0.21	0.50
			Mean 193	(34) 0.766	1.15

Figures in parentheses indicate number of observations at given temperature.

TABLE 4 OPERATING FORCE FOR THREE EIGHT-HOUR SHIFTS

Title	No. required per shift 1 unit	2 units	Duties
Boiler engineer[1]	1	1	Responsible for the proper operation and maintenance of all boiler-room apparatus and coal- and ash-handling systems.
Boiler operator	1	1	In general charge of boiler operation during his shift. Reports to boiler engineer.
Stoker operator	3	6	Each operates two boilers, including stokers, clinker grinders, dampers, etc.
Soot-blower operator	1	1	Operates soot blowers on each boiler once during the shift.
Larry operator	1	1	Weighs and distributes coal to stoker hoppers, keeping all active boilers supplied. In order to provide a consistent record for daily heat balance, hoppers on all active boilers are filled full between 11:30 and midnight.

[1] Day shift only.

TABLE 5 COAL- AND ASH-HANDLING FORCE, ONE TEN-HOUR SHIFT ONLY

Title	No. required 1 unit	2 units	Duties
Coal Handling			
Coal foreman	1	1	In charge of coal handling to bunker.
Coal-conveyor operators	2	2	Operate crushers and conveyor system.
Coal laborers	2	2	Dump coal cars.
Ash Handling			
Crane operator	1	1	Operates locomotive crane in assisting to distribute ash; part time only.
Locomotive operator	1	1	Operates dinky locomotive in shunting coal cars; part time only.
Laborers	2	3	Load ashes to cars.
Miscellaneous			
Coal and ash sampler	1	1	Takes and mixes samples, etc.
Boiler Maintenance			
Boiler-repair man	2	3	Repair leaks, clean inside of tubes, etc.
Boiler-repair-man helper	1	2	
Stoker-repair man	2	2	Repair and overhaul stokers.
Stoker-repair-man helper	2	2	
Bricklayer	1	1	Repair brickwork
Bricklayer helper	1	2	
Furnace cleaners	2	2	Clean slag from tubes, etc.
Soot-Blower Maintenance			
Pipe-fitter	1	1	Repair soot blowers.
Pipe-fitter helper	1	1	

TABLE 6 SUMMARY OF BOILER DATA — DECEMBER, 1921 — COLFAX POWER STATION

Boiler No.	Lb. Water Evaporated	Lb. Coal Consumed	Hours Active	Efficiency, per cent	Rating, per cent	Exit Gas Temp., deg. fahr.	CO_2 per cent	Combust. in Refuse, per cent
1	60,020,000	6,638,060	559	76.6	172	489	9.9	26.67
2	55,291,000	6,089,230	480	76.9	185	482	12.0	26.89
3	75,435,000	8,319,030	696	76.7	174	460	10.3	28.60
4	75,542,000	8,324,290	691	76.8	175	481	11.9	25.71
5	32,242,000	3,519,710	285	77.5	183	—	11.5	29.55
6	73,474,000	8,138,360	688	76.5	171	479	11.7	26.88
8	70,546,000	7,761,900	640	77.0	171	481	11.0	27.18
Total	442,550,000	48,790,580	4038	76.8	176	478	11.2	26.99

Average superheat, 132 deg. fahr.
Average feed temperature, 193 deg. fahr.
Average B.t.u. in coal, 13,283 per lb.

The evaporators have in general given satisfactory service. They are so connected that either river or deep-well water may be used. The river water, although very dirty, was found to contain less scale-forming salts than that from the wells, and is therefore generally used. The effects are reversed every four hours, thus minimizing scale formation. The thermal efficiency of the evaporators is practically 100 per cent, and with the modifications now being made it is thought they will give no trouble.

Water qualities throughout the cycle are closely watched. A multiple-point, indicating conductivity meter with cells located at various points is used to observe the water purity continuously.

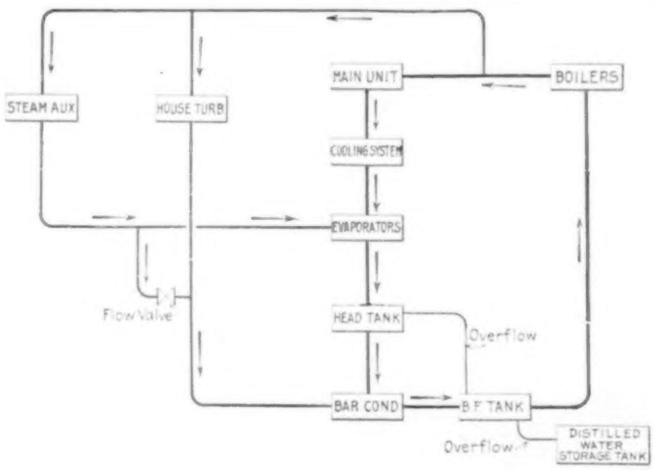

Fig. 7 Diagram of Steam and Feedwater Cycle

This instrument immediately indicates leakage of circulating water into the condenser and permits a close check in the quality of the distillate from the evaporators. No condenser leakage

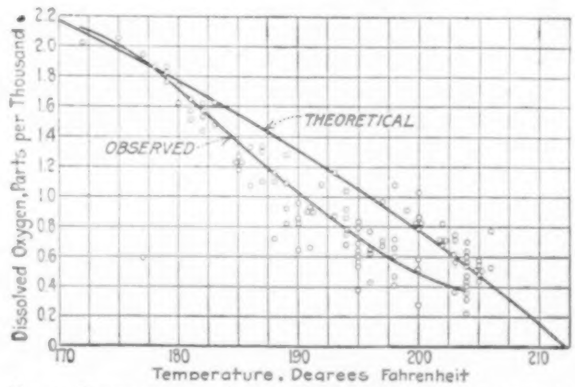

Fig. 8 Comparison of Actual Dissolved Oxygen in Colfax Boiler Feedwater with Theoretical Solubility at Varying Temperatures

TABLE 7 SIX MONTHS' SUMMARY OF BOILER DATA — COLFAX POWER STATION AUGUST, 1921, TO JANUARY, 1922, INCLUSIVE

	August	September	October	November	December	January	Average
Total water evaporated, lb.	272,779,000	265,373,000	292,355,000	248,858,000	442,550,000	313,703,500	305,936,417
Total coal consumed, lb.	30,085,600	28,023,100	31,690,300	27,109,300	48,790,600	35,911,530	33,601,738
Total active service, hours	2,782	2,493	2,474	2,361	4,038	2,894	2,840
Average feed temp., deg. fahr.	208	210	203	204	193	204	204
Average superheat, deg. fahr.	124	120	127	127	132	136	128
Average B.t.u. in coal per lb.	13,093	13,180	13,159	13,198	13,283	13,177	13,182
Average efficiency, per cent	76.4	78.9	78.0	77.2	76.8	77.6	77.5
Average rating, per cent	154	167	187	167	176	168	170
Average exit gas temp., deg. fahr	466	460	465	467	478	471	468
Average CO_2, per cent	9.2	9.3	9.6	10.3	11.2	11.1	10.1

tors is here condensed, bringing the temperature of the mixture to about 205 deg. fahr.

The storage tank employed has a capacity of 200,000 gal. and serves to take up fluctuations in the demand for feedwater and to provide a reserve supply for emergencies.

has as yet been detected, but much useful information on the performance of the evaporators has been obtained.

It has been found that dissolved oxygen in the feedwater tends to pit the boiler drums. It has also been determined that this pitting takes place during banked periods, there being practically

none when the boiler is active. In order to decrease the quantity of dissolved oxygen to the lowest possible point, all parts of the feed cycle are effectually sealed against air. The feed temperature is maintained at 205 deg. or higher to drive out the entrained air. Further experiments are being carried on to determine whether a lower feed temperature with a higher vacuum in the barometric condenser will improve this condition.

Fig. 8 shows the relation between temperature and oxygen content as observed at Colfax. Table 3 gives the results of observations of dissolved oxygen in the boiler feedwater taken from the condensate-head tank and the boiler-feed tank.

TABLE 8 TYPICAL HEAT BALANCE DATA—COLFAX STATION

	October		November		December		January	
Coal as fired, B.t.u. per lb.	13,159		13,198		13,283		13,177	
Ash, as fired, per cent	9.28		9.37		9.14		9.05	
Moisture, as fired, per cent	4.45		4.12		3.91		4.49	
Inlet air temp. deg fahr.	70		70		70		70	
Exit gas temp. deg fahr.	465		467		478		471	
Carbon as fired, per cent	72.29		72.49		72.86		72.45	
Hydrogen as fired, per cent	4.92		4.93		4.96		4.93	
CO_2, per cent	9.5		10.3		11.2		11.1	
Combustible in refuse, per cent	26.36		29.10		26.99		26.76	
	B.t.u.	per cent	B.t.u.	per cent	B.t.u.	per cent	B.t.u.	per cent
Heat absorbed by boilers	10,264	78.00	10,189	77.20	10,202	76.8	10,225	77.60
Moisture loss	55	0.42	51	0.38	48	0.36	56	0.42
Hydrogen loss	545	4.14	547	4.14	522	4.16	548	4.15
Stack loss	1,713	13.02	1,585	12.01	1,522	11.46	1,502	11.40
Ashpit loss	482	3.66	558	4.23	490	3.69	479	3.64
Heat accounted for	13,059	99.24	12,930	97.96	12,814	96.47	12,810	97.21
Heat unaccounted for	100	0.76	268	2.04	469	3.53	367	2.79
Total	13,159	100.00	13,198	100.00	13,283	100.00	13,177	100.00

Tables 4 and 5 show the personnel of the boiler-room organization with one unit as at present, and as it will be when a second unit is installed.

Table 6 is a summary of boiler-room operations for the month of December, and Table 7 a recapitulation for the six months, August to January, inclusive.

The heat balance for the station is worked out daily Table 8 shows the averages of the heat-balance figures for the months of October to January, inclusive.

Conclusions

In considering the results given in the paper the following points should be borne in mind:

a The operating results given are from the records of the operating department of the Duquesne Light Company

b The plant is not equipped with heat-reclamation equipment such as economizers or air preheaters

c The efficiencies given are not test results but have been made with the regular operating force and can be maintained year after year. The results are good but do not represent the best performance possible with the equipment. Some further improvement is expected as the operating force becomes more familiar with the equipment

d The amount of combustible in the ash is high, but as explained above, the necessity for early quenching of the ash to prevent clinker makes improvement in this respect doubtful. In the light of over-all efficiency the slight excess in combustible is a lesser loss than the formation of hard clinker masses would occasion.

POWER DEVELOPMENT IN SOUTHEAST

(*Continued from page 294*)

The lowest stream flow ever recorded was 6900 sec-ft., which corresponds to a load of 43,125 kw. under the proposed plans for the development.

The greatest fluctuation in any stream in the Southeast probably occurs in the Tennessee River. The United States Government in planning a development at Muscle Shoals recognized this fact and contemplated an installation of 400,000 kw., only a portion of which can be depended upon for continuous power. According to the hydrographs of the river at this point, the amount of strictly primary power at Muscle Shoals averages about 100,000 hp., and even this figure is based on the assistance of some steam capacity which must be maintained. It is a source of considerable regret to engineers who are familiar with the Tennessee River to read in the press of the enormous amount of power allotted to Muscle Shoals development, usually stated as 1,000,000 hp., and the consequent misleading of the general public on this much discussed project. The development has distinctly a stream-flow characteristic, the discharge of the river varying widely from month to month, and more markedly from year to year. The contemplated capacity of 400,000 kw. at Muscle Shoals could be operated under full load only at widely separated intervals, since the river flow does not equal this amount of power except on an average of less than thirty consecutive days per year.

In Fig. 3 are shown hydrographs of the Tennessee River at Florence, Ala., for the year 1906, which is the maximum water year recorded, and for 1904, which is the minimum water year recorded. It will be noted from the curve for 1904 that for a large part of the year the flow at Dam No. 2 would have produced only approximately 50,000 kw., while in the maximum water year, for a large part of the time, the flow falls below 200,000 kw. In studying the hydrographs of this stream covering a period of approximately thirty years, the years 1900 and 1907 have been found to represent about the average conditions of river flow. The hydrographs for these two years are shown in Fig. 4, and it will be noted that the continuous output that can be depended upon throughout these average years is in the neighborhood of 100,000 kw.

In Fig. 5 is shown a powergraph of the river for four consecutive years, 1912, 1913, 1914, and 1915, which are typical years, based on an installation of 400,000 kw. capacity, as proposed by the United States Government at Dam Site No. 2. It will be noted that in each of these years except one the stream flow at some times falls below 100,000 kw., and that only at widely separated intervals does the stream flow equal or approach the 400,000-kw. mark. It can be seen from these hydrographs that the statement of one million horsepower which has appeared in the press repeatedly, is a gross exaggeration of the output to be expected from the plant at this location. There are many undeveloped water-power sites in the Southeast which can be developed on a commercial basis to much greater advantage than the development at Muscle Shoals.

From the foregoing it can be seen that the Southeast is open for great industrial development, as it either has or can develop the necessary hydroelectric power, and enjoys the natural advantage of an even and salubrious climate, together with a very large store of raw materials in both its agricultural and mineral resources.

Results of an investigation made by the U. S. Geological Survey in 1921 show that the total water power developed in the United States is now 7,852,948 hp., the figure representing the capacity of the water wheels installed in plants of 100 hp. or more. There are 3116 such plants; 79 per cent of their total capacity is in public-utility plants and 21 per cent in manufacturing plants. Undeveloped water-power resources are shown to be a minimum of 27,943,000 hp., based on low-flow data.

Modern Shop Practice in the Building of Revolving Flat Cards

Details of Special Machines Developed for the Work—Production Cost Per Unit Lowered by Efficient Shop Arrangement, Careful Machine Designing and Standardization

By F. E. BANFIELD, JR.,[1] NEWTON UPPER FALLS, MASS.

BEFORE taking up the details of manufacture of the modern revolving flat card, it may be of interest to trace briefly the development of this machine in order that one may better appreciate the extent to which the art of its manufacture has been developed.

The primitive method of carding or cleaning cotton fibers was by means of hand cards which consisted of brushes made of short pieces of wire instead of bristles, the wires being fastened into a sheet of leather at a certain angle, and the leather fastened into a flat piece of wood about twelve inches long by five inches wide and provided with a handle. The cotton was spread upon the surface of one of these cards and then combed with another until all the fibers were straight, after which it was stripped off in the form of a roll.

The first attempt to card by the rotary motion of a cylinder was covered by the English patent taken out by Lewis Paul in 1748, but it was not until 1790, when Samuel Slater, an Englishman who had settled in Pawtucket, R. I., built the first cards to be operated in this country that carding or cleaning cotton fibers by machine was introduced here.

In 1857 Evan Leigh produced a card embodying all previous

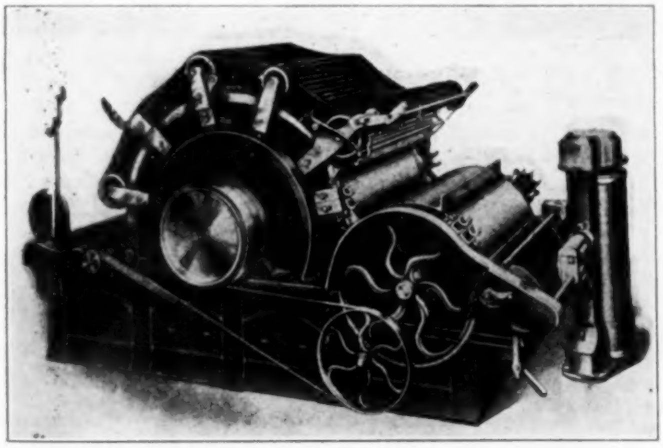

Fig. 1 Modern Revolving Flat Card

developments and having the additional advantage of being equipped with a mechanical device to automatically strip the tops or flats. This type, known as the revolving flat card, was destined to come into almost universal use and is today the standard of the world for carding cotton fibers. Although many modifications and improvements in the construction of this machine have since been made, its fundamental features remain the same.

In Fig. 1 is shown a revolving flat card as it is built today. While there are several different makes of these machines, varying somewhat in details of design, the essential features and characteristics are the same in all.

It was not until the year 1884–1885 that American manufacturers came to realize that the efficiency of this type of card was at least 100 per cent higher than the best of the wooden-top flat cards. As soon as this advantage was made apparent to mill owners the demand for these cards became large, and during the next decade English cards of this type were brought into this country by the shipload. It therefore became necessary for the American machine manufacturer to adopt this new design for his product in place of the old-style machine, in order to compete successfully with the English builders. He was not prepared to manufacture this radically different and highly developed machine. Many of its component parts were so designed that they were not readily adapted to machining on standard commercial types of tools. A start was made by purchasing from England such machines as were available, but it soon became apparent that it was up to the American manufacturer to devise and build special-purpose tools and equipment if he hoped to succeed against the English competitor.

It is the purpose of this paper to show some of the results of the efforts in this direction by describing some of the more important

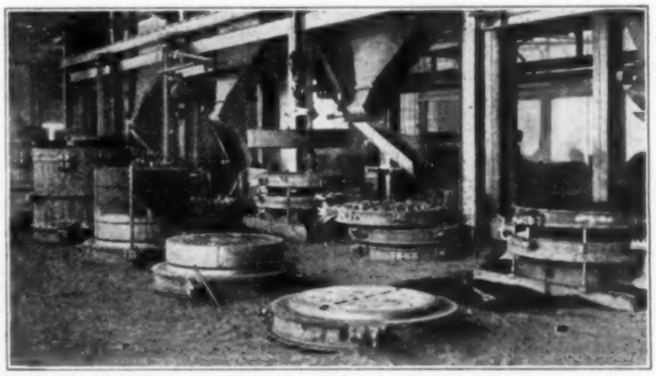

Fig. 2 Cylinder Molding Floor

machines which have been developed for this work. In designing these machines the one object which has been constantly borne in mind has been that they must not only do the work cheaper, but it must be of better quality.

One of the first requisites for economic machine-shop production on a quantity basis is carefully molded uniform castings; otherwise satisfactory work cannot be obtained from the jigs and fixtures employed in holding the castings for the subsequent machining operations. For the average card casting with its more or less deep draws and flanges, the stripping-plate type of molding machine has been found best suited. An iron pattern once properly fitted to a stripping plate is good for almost a countless number of castings, and thus made their accuracy in no wise depends upon the skill of the molder. In fact, an ordinary laborer can in a few days be taught to make as good castings from a stripping-plate pattern as a skilled molder who has served his time in a foundry.

Developments in molding machines in recent years have made it even possible to adapt the cylinder and doffer patterns to stripping-plate machines and in Fig. 2 we have a view of the cylinder floor showing some of these machines and illustrating the method by which the molds are built up. This equipment consists of four jolt stripping-plate machines, the drag, the cope, the core and cheek, the first two being seen at the center and the right of the photograph. The molds are shown from the right to left in their successive stages of completion. To provide for the flanges on the inside surface of the cylinder, the core is built up in four sections, one of which is seen suspended from the overhead crane by which it is handled. Each section is built upon a cast-steel arbor which serves as a means for handling and also provides a support for the upper cores. After the cores are in place the cheek is lowered into posi-

[1] Superintendent, Saco-Lowell Shops. Mem. Am.Soc.M.E.

Abstract of paper for presentation at the Spring Meeting, Atlanta, Ga., May 8 to 11, 1922, of The American Society of Mechanical Engineers. All papers are subject to revision.

tion and the mold is then closed with the cope and ready for pouring. This is done through a central sprue passing down through the cores and thence through radial gates in the drag to the cylinder wall.

Fig. 3 is a view of the card-side floor showing the pattern mounted on a stripping-plate machine at the right. The drags are made from this machine while the copes are rammed up on the plate at the left. In the foreground may be seen two drags ready for the cores to be set. Over 70,000 molds have been made from this pattern and it is still in serviceable condition.

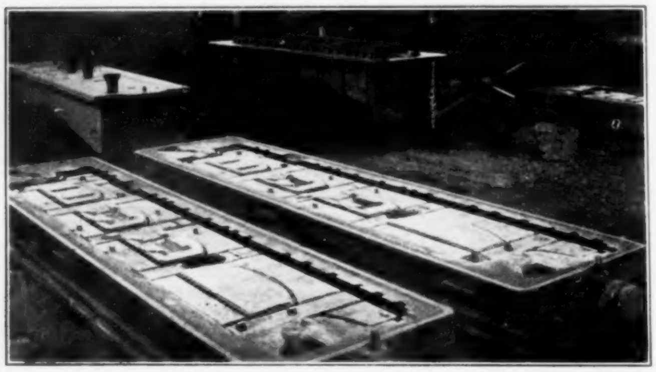

Fig. 3 Card-Side Molding Machines

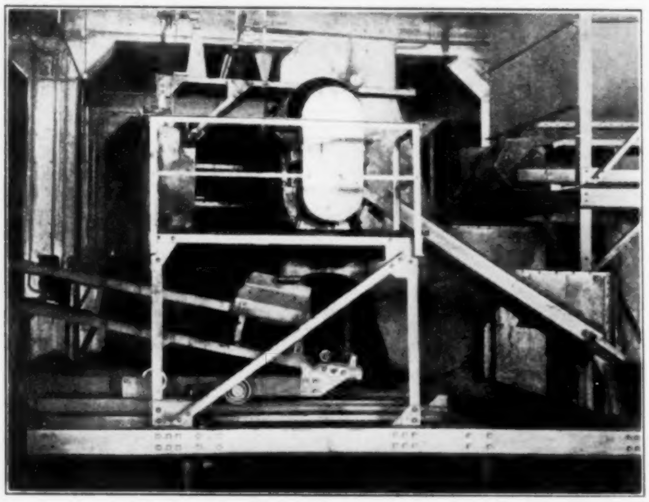

Fig. 4 Sand-Mixing Machine

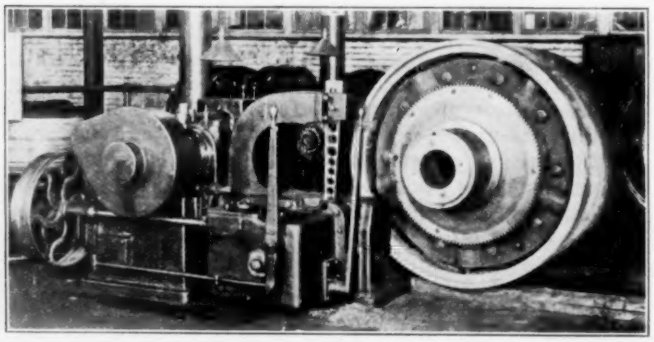

Fig. 5 Cylinder-End Milling Machine

After pouring, the molds are shaken out over gratings in the floor, through which the sand falls into hoppers located in the basement. Serving these hoppers is the sand-mixing machine or car, shown in Fig. 4. A hopper is located on the right from which a slow-moving feeder delivers the sand to the hopper of a bucket elevator mounted on the car. This elevates the sand to the mixing machine where it is riddled, tempered and mixed and then dropped on to a belt conveyor which delivers it to the bucket elevator at the left ready for the hopper over the molding floor above. This sand car is operated on a track, running the length of the foundry and so located that the car serves all of the hoppers in the bay in which it operates. This equipment does away with the laborious work of shoveling the sand and it also mixes and prepares it much more thoroughly than is possible by hand, thereby producing not only better but cheaper castings.

For transportation of materials, an electrically operated monorail system has been installed. Not only are the cars electrically driven but the switches are also operated in this manner, being controlled by a button in the operator's cab. Special cars are also arranged with ladles for carrying the molten iron from the cupola to the molding floors, and arranged so that the tilting of the ladle for pouring is done by the operator of the car. This system has aided materially in reducing the cost of transportation as well as increasing the capacity of the foundry by speeding up the work.

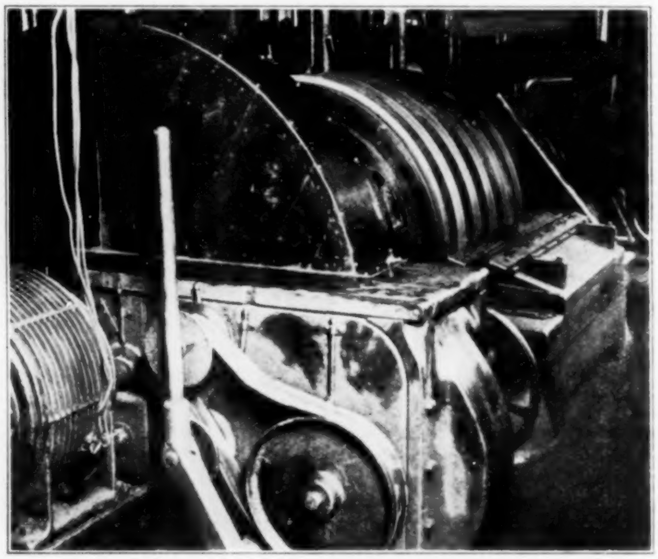

Fig. 6 Cylinder Roughing Lathe

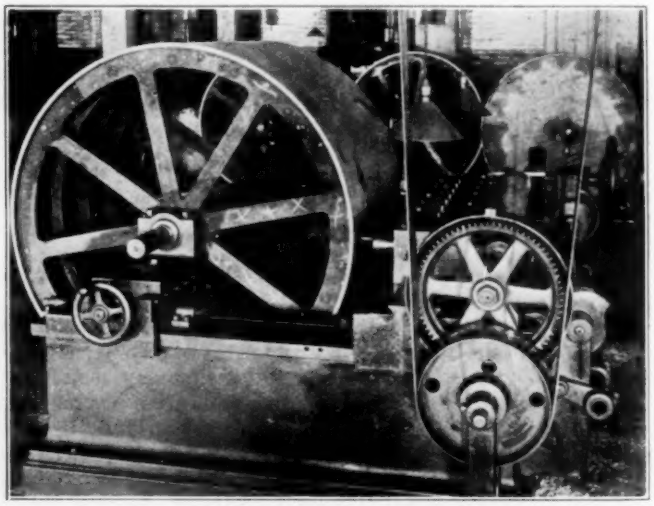

Fig. 7 Cylinder Drilling Machine

Machining of the Castings

Upon the solid construction, the true running and the perfect balance of the card cylinder, depends to a large degree the successful operation of the card. Its surface is covered with card clothing which in turn is set to run but a few thousandths of an inch away from the surfaces of the lickerin, the flats and the doffer, and it is

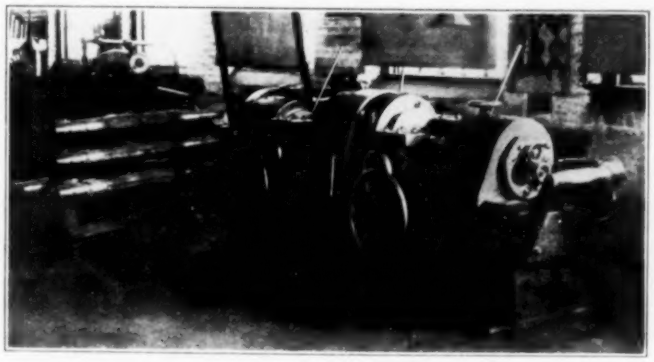

Fig. 8 Shaft Roughing Lathe

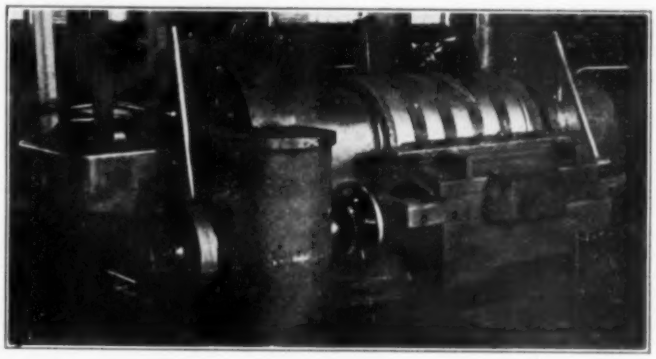

Fig. 9 Doffer Roughing Lathe

essential that this small clearance be accurately maintained as otherwise serious damage might result to the clothing. This cylinder has a diameter of 50 in., a length of 40 or 45 in. according to the width of the card, and runs at a normal speed of 165 turns per minute. It is the largest of the parts entering into the assembly of the card and its machining operations are such as require the use of several of the special single-purpose tools heretofore mentioned.

The first operation on the cylinder consists of squaring up and boring out the ends to receive the spiders. For a long time this was done on boring out lathes designed and built for this purpose in England, several of which were purchased and brought to this country.

Then in order to obtain an increased production and at the same time eliminate the possibility of inaccuracy, it was decided that a milling machine was the type best suited to produce these results. Accordingly the special machine shown in Fig. 5 was designed and built for this work. The cylinder is held on an expanding arbor or chuck, one end of which carries the feed gear corresponding to the rack of the ordinary milling-machine table. The cutters are mounted on the inner ends of two spindles, one on each side of the machine, these spindles, in turn, being driven by spur gears from a motor-driven cross-shaft at the rear. The spindles are mounted in quills so arranged that they may be fed into the ends of the cylinder to the desired depth after it has been rolled into place. A sliding-drive pinion is then moved into mesh with the feed gear on the chuck; this pinion being driven from the cross-shaft shown on the side of the machine. A tight and loose pulley on this shaft receives a belt from a pulley on the motor shaft, the feed being started and stopped by the shifting of this belt. The arbor on which the cylinder is mounted is held in position in the horizontal U-shaped bearings of the machine by means of the steel wedges shown. The photograph shows the cylinder ready to be rolled into position. The head carrying the cutter spindles is adjustable and when once set for a certain diameter of cutter, work of uniform dimensions is produced and is not dependent on the care of the operator, who merely loads and unloads the machine. This machine is capable of finishing one cylinder per hour, one-third the time required on the previous lathes.

When bored or milled out the cylinder is taken to the roughing lathe (Fig. 6) where it is held by the bored ends and a roughing cut is taken across its outer surface. To convey an idea of the size of this machine, it may be of interest to state that the head- and tail-stock spindles are both 30 in. in diameter, the former carrying a driving gear 6 ft. in diameter. The spindles are of cast iron and run in cast-iron bearings, which have shown no appreciable wear during ten years of continuous service. The tool block carries six tools spaced at equal intervals so that each tool travels but one-sixth of the length of the cylinder, the entire surface being finished by this movement.

A spider is then driven into each end of the cylinder where it is securely bolted and doweled in place. The holes are then line-reamed to receive the shaft, which is pressed into place in a heavy horizontal power press, 0.005 in. being allowed for the forced fit. As a further precaution, a $^5/_8$-in. dowel pin is driven through the hub of the spider and shaft at the driving end. This method of construction obviates any possibility of the shaft becoming loose from long-continued operation and insures a true-running cylinder.

It is then mounted on its own bearings in a special finishing lathe where a continuous chip is taken from one end to the other with a single tool, after which it is ready to be drilled for the wooden plugs which are driven into its surface and to which the clothing is tacked. This drilling operation is performed in the horizontal gang drilling machine shown in Fig. 7. The drills used here are of the flat type and so shaped as to drill and ream a tapered hole suitable for receiving the wooden plug.

After plugging, the cylinder is carefully ground on a special cylinder grinder. Operations on the spider, consisting of boring and reaming the hub, of turning the outside circumference to size and of facing one side of the rim, are done on a boring mill so equipped that all of these operations may be performed at one setting of the work.

Finishing the Shafts

The shafts used in the cylinders and doffers are of cast iron and each end is finished to three different diameters, one to fit the spider, one the bearing, and the third, or outer one, the pulley. For rough-turning these shafts the special machine shown in Fig. 8 was developed to turn both ends of the shaft at the same time. As

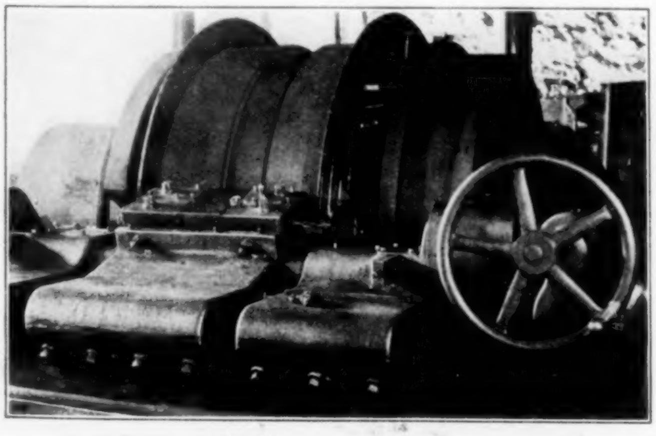

Fig. 10 Arch Milling

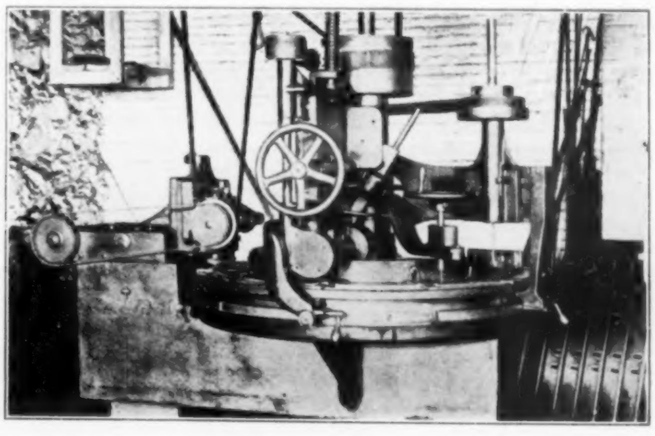

Fig. 11 Arch Milling, Drilling and Tapping

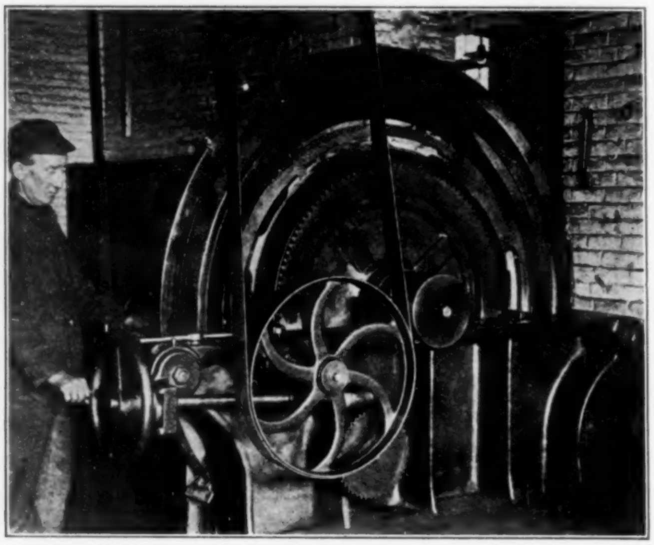

Fig. 12 Flexible-Bend Milling Machine

will be seen, the central head carries a hollow spindle driven by a gear on the main driving shaft at the rear of the machine. On each end of this hollow spindle is mounted a special concentric chuck for centering and gripping the casting to be turned. The tailstock spindles, one at each end of the machine, are arranged in horizontal turrets or drums which may be rotated in their respective heads and whose axes are located below that of the driving spindle. These turrets are also fitted with a rotating center drill, the driving gears of which are thrown into mesh as it is moved up into line with the axis of the shaft. The third position of the left-hand turret carries a stop which locates the work in the machine, while the corresponding position of the right-hand one is provided with an opening through which the work is passed into and out of the machine. Each carriage is provided with a front and back tool block, the former carrying two turning tools, while the latter carries a single inverted one. Thus, three tools are in operation at each end of the shaft, one for each of the three diameters.

The shaft then goes to a lathe equipped with two carriages, each of which is fitted with a tool block arranged with tools for squaring the shoulders to length. It is then ready for the grinder where both ends are carefully ground to size. After cutting the keyway for the driving pulley with a vertical end mill, the hole for the oil screw is drilled and tapped in the end and the shaft is completed, ready to be pressed into the cylinder.

The operations of finishing the doffer follow closely those of the cylinder, the rough-turning being done on the machine shown in Fig. 9, which greatly resembles the cylinder roughing lathe (Fig. 6). After the spider and shaft are in place, the doffer is drilled, ground, and balanced in a manner similar to the cylinder.

The sides and arches of the framework of the cards are finished by special machines since the successful manufacture of these parts requires close adherence to accuracy in order to insure interchangeability and to reduce to a minimum the fitting required in the erecting room. In order to secure a straight and even surface on which to erect the card and attain proper alignment of the bearings, the top surfaces of the sides are further finished on a special planer type of grinder carrying a vertically mounted motor-driven ring wheel.

The arch which is that portion of the frame carrying the stands which support the flats and their driving and adjusting mechanism as well as the sheet-iron casing below them, is by the nature of its design, the most awkward as well as one of the most important parts of the card to machine. The proper settings of the different parts require the accurate location of the various spottings on which the stands are mounted. The first operation after squaring off the bottom of the feet is the milling of the outer rim, this being done on the machine shown in Fig. 10. The rotating drum carries a pair of these arches, one right and one left hand. As this drum rotates slowly the circumference of the rim of the arch is carried past the cutter, plainly seen in the photograph, while below this cutter, but hidden from view, are two face mills so located as to mill the inner and outer sides of the rim. Means are also provided for automatically changing the space between these two cutters to allow for the thicker portion of the rim on one side of the arch.

The final operations on the arch are accomplished at one setting on the machine shown in Fig. 11. The casting is clamped to the table in a horizontal position on its back and the pair of cutters mounted on the horizontal slide at the left side of the machine serve to mill the spottings to which the arch stands are bolted, while the pair of cutters carried on the vertical head in the center of the picture finish the spottings on both sides of the flange. In addition to these milling operations, the holes for the capscrews securing the stands in place are drilled and tapped. The table of the machine is revolved by hand to its successive positions under the horizontal cutters, while the vertical milling, drilling and tapping heads are free to swing about the central axis to any desired position. The locations of the various spottings and holes are all determined by tapered slots in the rim of the table into which plungers, mounted on their respective heads, are thrust to locate the spotting or hole to be finished.

Against the outer rim of the arch, the flexible bend, over which the flats travel, is held by its adjusting blocks. It is essential that this bend be close to the milled surface of the arch and its sides

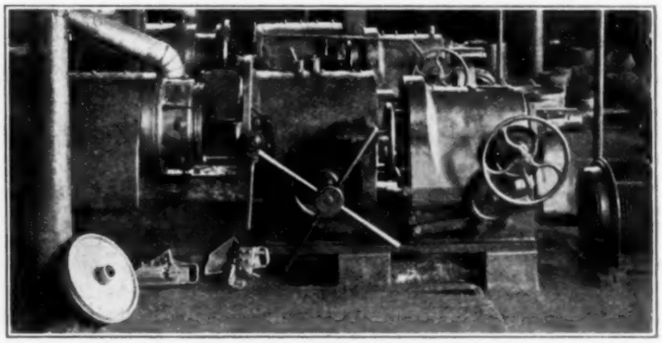

Fig. 13 Pulley Lathe

must therefore be true and even. The finishing of these sides is accomplished as in the case of the rim of the arch, by feeding the bend between two properly spaced face mills and removing the scale from both sides of the casting at the same time. This operation is shown in Fig. 12. It will be noted that this machine is of a type similar to some of the continuous milling machines which have been recently developed, where the loading and unloading is carried on while the machine is in operation. A rough casting may be seen entering the cutters, while in the rear the finished one is just coming into sight. The cutters are hidden from view in the cut,

(*Continued on page 310*)

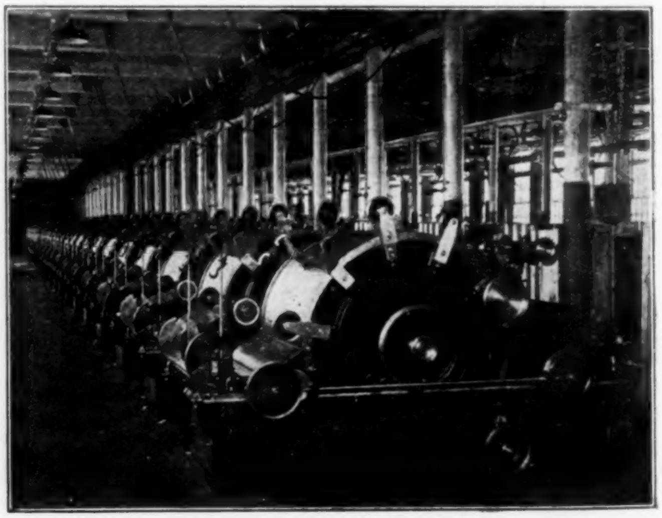

Fig. 14 Erecting Floor

The Value of Clean Blast-Furnace Gas

Savings Resulting from the Use of Clean Gas in Hot-Blast Stove and Boiler Operation—Superiority of Dry Cleaning Over Wet Cleaning—Possibilities Held Out by the Electrical Cleaning Process

By N. H. Gellert,[1] Philadelphia, Pa.

There are so many factors entering into the general problem of making iron from iron ore that the blast-furnace superintendent is often at a loss to determine which of all of these is most important. The experienced operator has undoubtedly long ago arrived at the conclusion that many contingent, equally important factors make up his general problem, and looks for no panacea to remedy all his ills. Some operators, having tried several remedies, and having failed to find them as effective as originally supposed, have despaired of discovering in the future definite specifics for blast-furnace troubles. Such operators are few today and will be fewer in number tomorrow.

Steel and fuel have made our country strong and powerful among nations. We must look to our continued supremacy in these to maintain ourselves in that eminence of world power to which they have helped to raise us. This supremacy, however, can be maintained only by the most careful conservation of all our fuel resources, so that it may be possible for steel men to produce the sinews of world industry with the minimum expenditure of power.

Our geologists tell us that we are reaching the end of our known fuel resources, and that at the present rate of consumption, the end is measured by scores of years and not by centuries. In view of such a condition, it becomes not only the advisable business policy to effect a rigid conservation of our fuel resources, but the major part of duty also. Such conservation can be effected in a large measure by steel men. Each stage of steel making requires its huge quota of fuel. In each stage of steel making savings can be secured.

We are especially interested at this particular moment, however, with the consideration of the savings to be effected by the cleaning of blast-furnace gas. To this specific consideration, therefore, the remainder of the discussion will be confined.

The Value of Clean Gas in Stoves and Boilers

The value of clean gas as against dirty or raw gas has been so well demonstrated that it might seem superfluous to most blast-furnace men to start any discussion on such a score. The policy of our largest and most progressive steel companies has been definitely established by the expenditure of millions of dollars to install cleaners, so that raw gas may not be fed to the boilers and hot stoves.

If the gas issuing from a blast furnace were a small item, overlooking its importance might be permissible, but the facts are these:[2]

1 Forty-eight to fifty per cent of the thermal value of the coke charged into the blast furnace issues from it in the form of latent and sensible heat of combustible gases.

2 Thirty per cent of the gas generated is used for increasing the temperature of the blast.

3 Sixty per cent of the gas is used in boilers or engines for power.

Consider for a moment what clean gas will do for hot stoves. At Duquesne[3] tests were made on hot-stove operation using gas in three different conditions. The results obtained as given in Table 1, are at least interesting.

TABLE 1 AVAILABLE HEAT IN CLEAN AND DIRTY GAS

Kind of Gas	Dust content, grains per cu. ft.	Moisture content, grains per cu. ft.	Temp. of gas, deg. fahr.	Available heat, per cent
Raw gas	3.0	35.0	400	77.03
Partly clean gas	...	saturated	125	74.33
Clean gas	0.2	7.98	70	79.51

[1] President, Gellert Engineering Company.

[2] A. N. Diehl, Burning Blast-Furnace Gas, Proc. Am. Iron & Steel Inst., 1915, p. 315.

[3] A. N. Diehl, A.I.M.E., Dec., 1913.

Abridgement of a paper read before the Birmingham Section of The American Society of Mechanical Engineers, Birmingham, Ala., October 28, 1921.

Mr. Diehl's conclusions, drawn from a careful investigation of his data, were that at 1913 prices the following savings were made:

1 Increased stove efficiency	\$0.0998
2 Saving in limestone	0.0072
3 Saving due to increased production	0.0521
Total saving per ton of iron	\$0.1591

Now in none of these figures was any consideration taken of the increased life of the stoves, of the more continuous operation because of a decreased number of cleaning periods, or of the savings due to better combustion and other beneficial results when using clean gas in the boilers. Unfortunately, no really determining data have been made available to enable us to determine just what such savings might be. It is evident, nevertheless, that they must be considerable, as to them must be credited savings (1) in checker brick in stoves, (2) in stove linings, (3) in combustion-chamber brick, (4) in boiler-setting brick, (5) in boiler tubes, (6) in boiler fuel, and (7) in labor cleaning outside of boiler tubes.

Interesting data on boiler efficiencies were given by Mr. Diehl in the paper already mentioned, and results which he has tabulated indicate that when burning clean gas the average thermal efficiency was 66.1 per cent, while when burning raw gas it was 62.3, making a gain of 3.8 per cent when burning clean gas. Since, however, the clean-gas tests were run after the boiler tubes had been cleaned and the whole boiler put in good shape, it is obviously impossible to say just how much of this saving is due to the burning of clean gas. It may be said, however, that the results indicate clearly that a saving is to be procured when burning clean gas, since the removal of dirt from the tubes and the burning of clean gas made it possible to get the high efficiencies recorded. Such a conclusion is checked by other tests reported by Mr. Diehl in which one boiler burning raw gas had an average efficiency of 49.8 per cent, while another burning clean gas—both using common burners—had an efficiency of 51.2 per cent.

Dry Versus Wet Cleaning

Now if it is conceded, by force of common practice and such data as can be used for argument, that clean gas is to be preferred above dirty gas in stoves and boilers, there remains but one other question to be answered: Shall gas be cleaned by a wet process or a dry process?

Heat Value of Dry-Cleaned Gas. Suppose we consider the operation of a 500-ton furnace here in the Birmingham District. If every ton of iron required 2500 lb. of coke, the total coke tonnage per day will be 625 tons. If we take 48 per cent of this to be in the form of gas, then 301 tons must be used for fuel purposes outside of the furnace. Here is presented a possibility for control that should result in savings.

Now there will be about 170,000 cu. ft. of gas generated per ton of iron made. At a 500-ton furnace this would give 85,000,000 cu. ft. of gas per day, 3,540,000 cu. ft. of gas per hour, or 59,000 cu. ft. per min. at 29.92 in. of mercury column pressure and 62 deg. fahr.

Assume the gas has a percentage analysis as follows: CO_2, 12.5; CO, 25.4; H_2, 3.5; N_2, 58.6. Assume also that the temperature of the gas in the mains is 400 deg. fahr. and the moisture at standard conditions is 35 grains per cu. ft.

The thermal value of the gas depends on (1) its latent heat of combustion and (2) its sensible heat; and if the products of combustion escape at, say, 600 deg. fahr., there will have to be subtracted from the total heat the sensible heat of the escaping products of combustion.

Latent Heat. First consider the thermal value of the gas.

Table 2, the author believes, is the first published attempt to assemble the data given from a number of sources so as to collect the most probable values of the constants involved In addition

values have been calculated to correspond to a temperature of 62 deg. fahr., the temperature at which most technical gas calculations are made.

By the aid of this table it now becomes a fairly simple task to develop the latent-heat value of the gas which is being considered.

We have available 59,000 cu. ft. of gas per minute at 62 deg. and 29.92 in. mercury column. Of this amount 14,986 cu. ft. are carbon monoxide and 2065 cu. ft. hydrogen. The hydrogen has a total latent-heat value of 676,100 B.t.u. and the carbon monoxide a total latent-heat value of 4,771,100 B.t.u., or for all the combustible elements, a total latent-heat value of 5,447,200 B.t.u. per min. See Table 3.

TABLE 2 PROPERTIES OF GASES

Name of Gas (1)	Specific Gravity (2)	Lb. per Cubic Ft. at 29.92 in. Hg. at 32° F. (3)	at 62° F. (4)	Heating Value B.t.u. per lb. (5)	B.t.u. per cu. ft. at 32° F. (6)	at 62° F. (7)	Air Required Lb. per lb. gas (8)	Cu. ft. per cu. ft. gas (9)	Oxygen Required Lb. per lb. gas (10)	Cu. ft. per Cu. ft. gas (11)	Cu. Ft. Gas per Lb. at 32° F. (12)	at 62° F. (13)
Carbon dioxide....	1.5291	0.1234	0.1163	....	.....	......	...	....	...	...	8.103	8.60
Carbon monoxide..	0.9672	0.0781	0.0736	4,325	337.6	318.2	2.47	2.391	.571	0.5	12.810	13.59
Hydrogen.........	0.0695	0.00561	0.00528	62,032	348.0	348.0	34.56	2.391	8.000	0.5	178.273	189.14
Oxygen...........	[1]1.1054	0.0892	0.0841	....	.....	......	...	....	...	...	11.209	11.90
Nitrogen..........	[1]0.9674	[2]0.0782	0.0737	....	.....	......	...	....	...	...	12.807	13.50
Air...............	1.0000	0.0807	0.0761	....	.....	......	...	....	...	...	12.390	13.14
Aqueous vapor.....	0.6237	0.0503	0.0474	....	.....	......	...	....	...	...	19.865	21.08
Methane..........	0.5545	0.0448	0.0422	23,513	1,053.4	992.2	17.28	9.564	4.000	2.0	22.324	23.70
Ethane...........	1.0496	0.0847	0.0799	22,230	1,882.9	1,776.1	16.13	16.737	3.733	3.5	11.807	12.51
Ethylene..........	0.9753	0.0787	0.0741	21,344	1,679.9	1,581.6	14.81	14.346	3.429	3.0	12.706	13.36
Acetylene.........	0.9056	0.0731	0.0688	18,196	1,330.1	1,251.9	13.29	11.955	3.077	2.5	13.680	14.63
Sulphur dioxide....	2.2639	0.1826	0.1721	....	.....	......	...	....	...	...	5.422	5.81
Sulphur...........	....	.....	.....	4,050	.....	......	4.32	....	1.000	...	.....	....
Carbon...........	....	.....	.....	14,600	.....	......	11.52	....	2.667	...	.....	....

[1] From Olsen's Manual. [2] Calculated. Columns 2 and 3, values from Liddell's Met. and Chem. Handbook; columns 4, 6, 7, 12, and 13, calculated; column 5, values from Poole's Calorific Power of Fuels; column 8, values from Babcock and Wilcox' Steam; columns 9, 10 and 11 from Pratt's Principles of Combustion.

Since, however, the water vapor formed in the combustion of the hydrogen is not condensed in the products of combustion, the lower heat value, 52,920 B.t.u. per lb., should hold. There must therefore be subtracted the difference between these two values for the total latent heat, or (62032 − 52920 =) 9112 × 10.9 = 99320.8 B.t.u. must be deducted, making the net value of the latent heat 5,347,900 B.t.u.

TABLE 3 LATENT HEAT OF COMBUSTION
(59,000 cu. ft. of blast-furnace gas per min.)

Constituent	Per cent by volume	Cu. ft. per min.	Weight per cu. ft. at 62° F., lb.	Total wt., lb.	Per cent by weight	Latent Heat in B.t.u. Per cu. ft. at 62° F.	Per lb.	Total
Carbon dioxide.....	12.5	7375	0.1163	838.3	18.6	...	...	....
Carbon monoxide.	25.4	14986	0.0736	1103.2	24.6	318.2	4325	4,771,100
Hydrogen.........	3.5	2065	0.0053	10.9	0.2	328.0	62032	676,100
Oxygen...........	0.0	0000	0.0841	000	00	...	...	....
Nitrogen..........	58.6	34574	0.0737	2548.3	56.6	...	...	....
Total...........				4500.7				5,447,200

Sensible Heat. To this, however, must be added the value of the sensible heat of the gas. This may be determined from the formulas given in Table 4, which hold true for values of gases up to 2000 deg. cent. (3600 deg. fahr.) in temperature.

TABLE 4 THERMAL CAPACITIES OF GASES PER POUND FOR TEMPERATURES UP TO 2000 DEG. CENT. (3600 DEG. FAHR.)[1]

Gas	Pound-Calories	B.t.u.
Hydrogen...........	$3.370 + 0.0003t$	$3.370 + 0.00017t$
Nitrogen............	$0.2405 + 0.0000214t$	$0.2405 + 0.0000119t$
Oxygen.............	$0.2104 + 0.0000187t$	$0.2104 + 0.0000104t$
Carbon dioxide......	$0.19 + 0.00011t$	$0.19 + 0.00006t$
Carbon monoxide....	$0.2405 + 0.0000214t$	$0.2405 + 0.0000119t$
Aqueous vapor......	$0.42 + 0.000185t$	$0.42 + 0.000103t$

[1] Tabulated from data in Richards' Metallurgical Calculations.

We may approach our problem then in one of two ways:

1 We may find the mean specific heat of the gas between the limit $(0-t_1)$, and also the mean specific heat of the same gas between the limits $(0-t_2)$. From the total sensible heat found in the first instance we may subtract the total sensible heat in the second leaving us a net result. Or,

2 We may find the mean specific heat between the limits (t_1-t_2) and use this direct to obtain our net sensible heat. For ease in calculating specific heats the formulas in Table 5 may be used.

TABLE 5 FORMULAS FOR SPECIFIC HEAT

Gas	B.t.u. per lb. per degree
Hydrogen..................................	$3.370 + 0.00017t$
Nitrogen and carbon monoxide..............	$0.2405 + 0.00000119t$
Oxygen....................................	$0.2104 + 0.0000104t$
Aqueous vapor.............................	$0.42 + 0.000103t$
Carbon dioxide............................	$0.19 + 0.00006t$

Take 500 lb. of carbon dioxide at 400 deg. fahr., to find its net sensible heat value if it enters a boiler when the air temperature is 70 deg. fahr. by the first method:

Specific heat of CO_2 (0°–400°) = 0.2140

Total sensible heat at 400 deg. fahr. = 0.2140 × 500 × 400 = 42,800 B.t.u.

Specific heat of CO_2 (0°–62°) = 0.1936

Total sensible heat at 62 deg. fahr. = 0.1936 × 500 × 62 = 6,002 B.t.u.

Net sensible heat (62°–400°) = 36,798 B.t.u.

In the above calculation the first method is used since it lends itself to greater clarity of thought and develops information as to the actual degree of heat energy of the gases in their various phases and at their various temperatures.

Now calculating the specific heat of the gas at 400 deg. fahr. the following results are obtained:

	Mean specific heat in B.t.u. per deg. fahr. per lb.
Carbon dioxide........................	0.2140
Carbon monoxide......................	0.24526
Hydrogen..............................	3.438
Nitrogen..............................	0.24526
Aqueous vapor........................	0.4612

Attention is here called to the fact that the specific heats here calculated do not agree with those obtained in later determinations

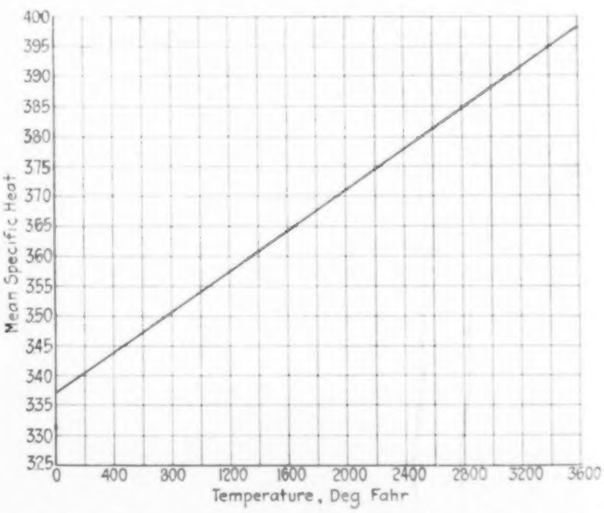

Fig. 1 Mean Specific Heat of Hydrogen between Limits 0 Deg. Fahr. and t Deg. Fahr.

of specific heats. In his Principles of Combustion, Arthur D. Pratt calls attention to the work of Holborn and Henning, Langen, Pier, and Austin, and considers the values as obtained by them the most authoritative for such investigations as we are here making. But since most of the past calculations have been based on Richards, the formulas given by him have been used in the present discussion.

Let us see now how the values of the specific heats may be used in our calculations.

In Table 6 we consider the weights of the components of the gas and the sensible heat they possess by reason of their specific heat at 400 deg. fahr., the temperature at which they are passed through the hot-stove and boiler burners for combustion.

This determination of sensible heat is based on values of specific

heats between the limits 0 deg. and 400 deg. fahr. To get an exact value they should be based on limits: temperature of air and 400 deg. fahr. Since this temperature varies from day to day and season to season, no data developed would hold exactly true. For purposes of comparison the method of determination used should give just as accurate, if not more accurate, results than a method in which daily temperatures must be estimated.

Assume, however, that this average temperature is 62 deg. fahr., the temperature used as a standard for gas-measurement comparison. We can then compute the total sensible heat at limits 0 deg.–62 deg. fahr. as in Table 7, and this subtracted from the sensible heat at the limits 0 deg.–400 deg. fahr. gives:

TABLE 6 DETERMINATION OF SENSIBLE HEAT OF BLAST-FURNACE GAS AT 400 DEG. FAHR.

Given: 1 Total cu. ft. per min. at 62 deg. fahr. and 29.92 in. Hg. dry basis = 59,000.
2 Moisture per cu. ft. dry basis (35 grains) = 0.005 lb.
3 Temperature of gas = 400 deg. fahr.
4 Percentage analysis, dry basis: CO_2, 12.50; CO, 25.40; H_2, 3.50; N, 58.60.

Constituent	Per cent by volume	Cu. ft. at 62° F.	Wt. per cu. ft. at 62° F.	Weight lbs.	Per cent by weight	Specific heat at 400° F.	B.t.u. per lb. at 400° F.	Total B.t.u.
CO_2	12.5	7,375	0.1163	838.3	18.6	0.2140	85.6	71,750
CO	25.4	14,986	0.0736	1103.2	24.6	0.24526	98.1	108,220
H	3.5	2,065	0.0053	10.9	0.2	3.438	1375.2	14,650
N	58.6	34,574	0.0737	2548.3	56.6	0.24526	98.1	249,990
[1]H_2O	....	....	[2]0.005	295.0	....	0.4612	184.5	54,430
Total	100.0	59,000		4795.7	100.0	[3]0.2414	[4]96.57	499,040

[1] Aqueous vapor.
[2] Per cubic foot on basis of dry gas.
[3] Average calculated value mean specific heat dry blast-furnace gas of above analysis.
[4] Per cubic foot dry gas.

Sensible Heat of Gas at 400 deg. fahr. = 499,040 − 74,390
= 424,650 B.t.u. per min.

TABLE 7 SENSIBLE HEAT OF BLAST-FURNACE GAS AT 62 DEG. FAHR.

Constituent	Weight lb.	Sp. ht. at 62° F.	B.t.u. per lb. at 62° F.	Total B.t.u.
Carbon dioxide	838.3	0.1937	12.0	10,100
Carbon monoxide	1103.2	0.2412	14.9	16,460
Hydrogen	10.9	3.3805	209.6	2,380
Nitrogen	2548.3	0.2412	14.9	37,970
Aqueous vapor	295.0	0.4264	25.4	7,480
Total	4795.7	0.2505		74,390

Total Heat of Gas. The total heat of the gas at 400 deg. fahr. will therefore be:

(1) Net latent heat of combustion	5,347,900
(2) Sensible heat of gas	424,650
Total thermal value	5,772,550 B.t.u. per min.

Combustion Products. Some of this heat will be lost in the escape of products of combustion at a temperature of 600 deg. fahr.

Now in a previous table the most probable values have been used as obtained from a number of sources, while the air and oxygen required were obtained from a source in which air was taken to consist of 23.15 per cent by weight of oxygen and 76.85 per cent of nitrogen. Since, however, our data show oxygen to weigh 0.0841 lb. per cu. ft. at 62 deg. fahr., while nitrogen weighs 0.0737 lb. per cu. ft. at the same temperature, the proportional parts in a cubic foot of air will be as given in Table 8.

TABLE 8 AIR-OXYGEN RATIO

Gas	Per cent by weight	Wt. per cu. ft.	Proportionate volume	Per cent by volume	Air-Oxygen by weight	Ratio by volume
Oxygen	23.15	0.0841	275	20.89	1.00	1.00
Nitrogen	76.85	0.0737	1043	79.11	3.32	3.79
Air	100.00	0.0761	1318	100.00	4.32	4.79

If, therefore, gas be burned by the combination with air, there will be present in the products of combustion, in addition to the new compounds formed, inert nitrogen amounting to 3.32 times the weight of the oxygen combined with the burning gases.

The combustion products when burning carbon monoxide and hydrogen will be as given in Table 9.

TABLE 9 COMBUSTION DATA

Constituent	Symbol	Air Required: Lb. per lb.	Air Required: Cu. ft. per cu. ft.	Products of Combustion: Lb. per lb. CO_2	Lb. per lb. H_2O	Lb. per lb. N_2	Cu. ft. per cu. ft. CO_2	Cu. ft. per cu. ft. H_2O	Cu. ft. per cu. ft. N_2
Carbon monoxide	CO	2.47	2.391	1.58	..	1.89	1	..	1.891
Hydrogen	H_2	34.56	2.391	..	9.00	26.56	..	1	1.891

It is now possible to proceed with the calculation of the combustion products of the 59,000 cu. ft. of gas at 62 deg. fahr. with which we started our discussion.

By developing the calculations further (see Table 10) we find that when the gas is burned the total products of combustion are:

Carbon dioxide	2,581.3 lb. or	22,361 cu. ft.
Water	393.1 lb. or	8,289 cu. ft.
Nitrogen	4,922.7 lb. or	66,818 cu. ft.
Total products of combustion	7,897.1 lb. or	97,468 cu. ft.

Sensible Heat of Combustion Products. These escaping products of combustion take with them out of the stack and into the air a portion of the heat by virtue of their thermal capacities. To know what heat is available for useful work, the sensible heat of

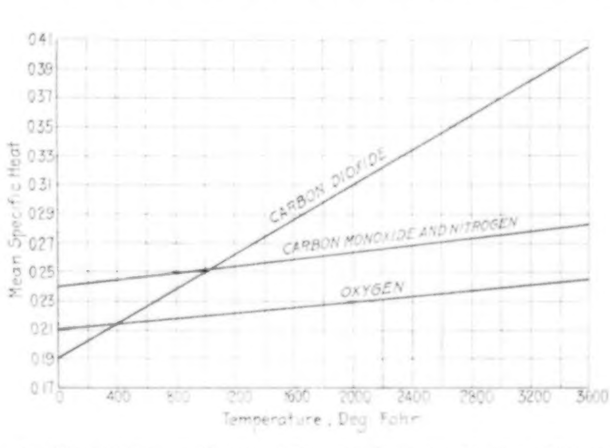

FIG. 2 MEAN SPECIFIC HEATS OF CARBON DIOXIDE, CARBON MONOXIDE, NITROGEN AND OXYGEN BETWEEN LIMITS 0 DEG. FAHR. AND t DEG. FAHR.

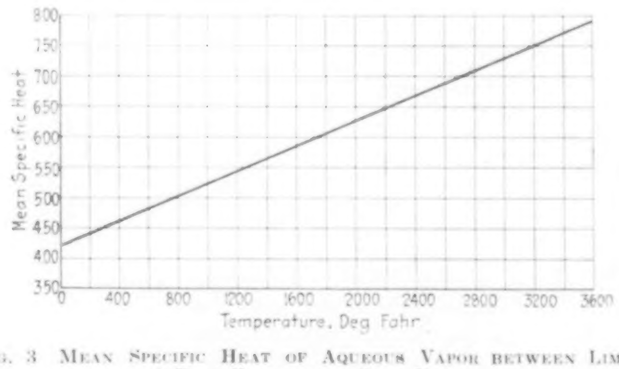

FIG. 3 MEAN SPECIFIC HEAT OF AQUEOUS VAPOR BETWEEN LIMITS 0 DEG. FAHR. AND t DEG. FAHR.

these products must be determined at a temperature of 600 deg. fahr. Using the formulas in Table 6, we are able to obtain the following values bearing on this determination:

	Mean Specific Heat in B.t.u. per Deg. Fahr. per Lb.
Carbon dioxide	0.2260
Aqueous vapor	0.4818
Nitrogen	0.24764

At 600 deg. each pound of product will have 600 times the thermal capacity here shown. The full analysis of the total thermal capacity of all the products can then be developed and this total

TABLE 10 PRODUCTS OF COMBUSTION OF BLAST-FURNACE GAS
(59,000 cu. ft. per min. at 62 deg. fahr.)

Constituent	Symbol	Per cent by vol.	Per cent by weight	Weight, lb.	Volume in cu. ft. at 62° F.	Total Air needed lb.	Total Air needed cu. ft.	Products: Total lb. CO_2	Total lb. H_2O	Total lb. N_2	Total cu. ft. at 62° F. CO_2	Total cu. ft. at 62° F. H_2O	Total cu. ft. at 62° F. N_2
Carbon dioxide	CO_2	12.5	18.6	838.3	7,375	....	....	838.3	...	....	7,375	..	..
Carbon monoxide	CO	25.4	24.6	1103.2	14,986	2724.8	35,832	1743.0	...	2084.9	14,986	..	28,339
Hydrogen	H_2	3.5	0.2	10.9	2,065	376.7	4,937	....	98.1	289.5	....	2065	3,905
Nitrogen	N_2	58.6	56.6	2548.3	34,574	....	....	....	...	2548.3	....	..	34,574
Aqueous vapor	H_2O	...	...	295.0	....	....	....	....	295.0	....	....	6224	..
Total		100.0	100.0	4795.7	59,000	3101.5	40,769	2581.3	393.1	4922.7	22,361	8289	66,818

sensible heat calculated to be 1,194,800 B.t.u., as shown in Table 11.

Here we must make the same corrections as made for the sensible heat of the gas. Our sensible-heat calculations for gases between the limits 0 deg. and 62 deg. fahr. are as given in Table 12 and the net sensible heat of the products of combustion will be 1,194,800 − 114,380 = 1,080,420 B.t.u. per min. We then have:

Total value of the original gas for both latent and sensible heat	5,772,550 B.t.u.
Net sensible heat of the products of combustion	1,080,420 B.t.u
Gross available B.t.u.	4,692,130 B.t.u.
Less 10 per cent lost because of original loss in gas	469,213 B.t.u.
Net available B.t.u. per minute	4,222,917 B.t.u.

TABLE 11 DETERMINATION OF SENSIBLE HEAT OF PRODUCTS OF COMBUSTION OF HOT GAS AT 600 DEG. FAHR.

Constituent	Per cent by volume[1]	Per cent by weight[1]	Cu. ft. at 62° F.	Total weight lb.	Specific heat at 600° F.	B.t.u. per lb. at 600° F.	Total B.t.u. sensible heat
Carbon dioxide	25.1	34.5	22361	2581.3	0.2260	135.60	350,020
Aqueous vapor	...	...	8289	393.1	0.4818	289.08	113,640
Nitrogen	74.9	65.5	66818	4922.7	0.2476	148.56	731,320
Total	100.0	100.0	97468	7897.1	0.2522		1,194,980

[1] Figured on a dry basis.

TABLE 12 SENSIBLE HEAT OF PRODUCTS OF COMBUSTION

Constituent	Weight lb.	Specific heat at 62° F.	B.t.u. per lb. at 62° F.	Total B.t.u.
Carbon dioxide	2581.3	0.1937	12.0	31,000
Nitrogen	4922.7	0.2412	14.9	73,400
Aqueous vapor	393.1	0.4264	25.4	9,980
Total	7897.1	0.2341		114,380

Available Heat and Flame Temperatures in Dry Cleaning

All these figures are based on the assumption that blast-furnace gas is delivered at 400 deg. fahr. to the burners of the hot stoves and boilers. This is, of course, what a dry-cleaning device would enable the operator to do. If, however, he is forced to clean his gas by a wet process there must necessarily be a reduction in temperature of the ingoing gas. This reduction in temperature, it is true, will reduce the moisture content of gas. Whether this reduction in moisture content is of any considerable value, or whether it can compensate for the losses in heat incident to the cooling of the gas, is something that might well be determined. To arrive at a conclusion approaching a semblance of accuracy, two things must be taken into account:

1 The comparison of the flame temperature of the burning gases
2 The comparison of net available B.t.u. of the gas.

We have already started our study of the available B.t.u. of hot gas containing 35 grains of moisture per cubic foot at 62 deg. fahr. and 29.92 in. Hg.

Flame Temperature. Let us consider for a moment the theoretical flame temperature of this gas.

$$T = \frac{\text{B.t.u. produced}^1}{W \times S_m}$$

where T = the elevation in temperature
W = weight of products of combustion, and
S_m = mean specific heat of products between temperature of fuel and air and that of products.

The exact value of S_m cannot be found until the value of T is known. For that reason a trial method of computation must be adopted.

The average temperature of the fuel and air will depend on the temperature at which each was delivered to the point of combustion. The gas was delivered at 400 deg. fahr., the air at 62 deg. fahr., and the temperature of the mixture can be shown to be about 251 deg. This figure is interesting but not necessary to our calculations as we already have the total thermal value of the gas before burning.

TABLE 13 SENSIBLE HEAT OF PRODUCTS OF COMBUSTION PER DEGREE

Constituent	Total wt., lb.	Sp. ht. at 2480° F.	Sensible heat per deg.	Sp. ht. at 2400° F.	Sensible heat per deg.	Sp. ht. at 2380° F.	Sensible heat per deg.
Carbon dioxide	2581.3	0.3388	875	0.3340	864	0.3328	860
Nitrogen	4922.7	0.2700	1330	0.2691	1320	0.2688	1320
Aqueous vapor	393.1	0.6754	265	0.6672	262	0.6651	260
Total		0.2138	2470		2446		2440

Proceeding now to the determination of flame temperature, let us assume 2480 deg. fahr. as the correct value. Then, dividing the B.t.u. produced by the sensible heat per degree at 2480 deg. fahr., as given in Table 13,

[1] From Pratt's Principles of Combustion.

$$T = \frac{5,772,500}{2470} = 2340$$

It is evident that this is the wrong temperature. Assuming 2400 deg. as the flame temperature,

$$T = \frac{5,772,500}{2446} = 2360$$

Again, taking 2380 deg.

$$T = \frac{5,772,500}{2440} = 2370$$

For our purposes we may take the halfway point between 2380 and 2370 or 2375 deg. fahr., as the correct flame temperature. Greater accuracy may of course be obtained by another trial.

Available Heat and Flame Temperature in Wet Cleaning

So far there have been determined for the gas which is considered as cleaned by a dry process:

1 A value for the available heat which has been found to be 4,222,917 B.t.u. per min. This is the net value after all losses are accounted for.

2 A value for the flame temperature which is 2375 deg. fahr.

We now approach the discussion of these same values when the gas is wet-cleaned. In this instance the gas will have the same analysis as before but its temperature will be 70 deg. fahr. and its moisture content 7.98 grains per cu. ft. of dry gas at 62 deg. and 29.92 in. Hg.

Latent Heat. Its latent heat will be exactly as before since the heat values of the combustible constituents of the gas have not changed. This gross latent-heat value was found to be 5,447,200 B.t.u. per min.

From this amount there was subtracted the difference between the gross and net value of the heat generated by the combustion of the hydrogen, since there was no condensation of the moisture in the products of combustion before escaping through the stack. In addition there was deducted a 10 per cent loss in gas itself.

With the deduction for the lower thermal value of hydrogen there was a net latent-heat value left of 5,347,900 B.t.u. This holds true with wet-cleaned gas also.

Sensible Heat. When we consider the matter of sensible heat, however, we have some differences to take into consideration.

The mean specific heats of the component parts of the gas at 70 deg. fahr. as calculated by the formulas in Table 5 are as follows:

Carbon dioxide	0.1942
Carbon monoxide and nitrogen	0.2413
Hydrogen	3.3819
Aqueous vapor	0.4272

With these values and such other data as we have already obtained, we may develop a table similar to Table 7 giving a total of 77,620 B.t.u. per min. for the sensible heat of all the gases. The total heat of the 59,000 cu. ft. of gas per min., therefore, is 5,347,900 + 77,620 = 5,425,520 B.t.u. per minute.

Combustion Products. Turning to the consideration of the products of combustion of this gas, we find that all the products will be the same excepting the moisture content which will be less by the difference between 295 lb. as found in gas containing 35 grains of moisture per cu. ft. and 67.3 lb. as found in gas containing only 7.98 grains per cu. ft. This difference is 227.7 lb. The products of combustion will therefore be:

Carbon dioxide	2,581.3 lb. or	22,361 cu. ft.
Aqueous vapor	165.4 lb. or	3,480 cu. ft.
Nitrogen	4,922.7 lb. or	66,818 cu. ft.
Total	7,669.4 lb. or	92,659 cu. ft.

These products must be assumed to escape at the same temperature as before in order to get a reasonably accurate comparison. If the stack temperature is 600 deg. fahr. as before, the specific heats of the products will be the same as before. The total sensible heat of each product will also be the same as before, excepting that of the aqueous vapor. In the previous calculation 393.1 lb. of aqueous vapor had a total sensible heat value of 113,640 B.t.u. or 289.08 B.t.u. per lb. Then 165.4 lb. of aqueous vapor will have a sensible-heat value of 47,814 B.t.u. and the total sensible heat of the combustion products will be: (CO_2, 350,020) + (N_2, 731,320) +

(H_2O, 47,220) = 1,128,560 B.t.u. per min. From this total there must be subtracted the heat energy present at 62 deg. fahr.

This will be the same as before, excepting for the aqueous vapor. In the former case 393.1 lb. aqueous vapor had a heat energy of 9980 B.t.u. per min. Then 165.4 lb. of aqueous vapor which we have to deal with in this latter case will have a heat energy at 62 deg. fahr. of 4190 B.t.u. per min. and the total energy will be: (CO_2, 31,000) + (N_2, 73,400) + (H_2O, 4,190) = 108,590 B.t.u. per min.

The net sensible heat of the products will therefore be 1,128,560 − 108,590 = 1,019,970 B.t.u. per min.

It is now possible to determine our net available heat.

Latent and sensible heat of gas	5,425,520
Less net sensible heat of combustion products	1,019,970
Gross available B.t.u.	4,405,550
Ten per cent gas loss	440,555
Net available B.t.u. per min.	3,964,995

Savings. We have already found that the net available B.t.u. per min. when burning hot gas with 35 grains of moisture per cu. ft. = 4,222,917, and now we have the net available B.t.u. per min. when burning cold gas with 7.98 grains of moisture per cu. ft. = 3,964,995, giving a difference in favor of hot gas of 257,922 B.t.u. per min. or 371,407,680 B.t.u. per day saving in using hot gas over wet-cleaned gas.

On the basis of 500 tons per day the saving will amount to 371,407,680 ÷ 500 = 742,820 B.t.u. per ton. Now Birmingham coke contains about 14,290 B.t.u. per lb. on a dry basis.[1] This would mean that 742,820 ÷ 14,290 = 52.0 lb. of coke is saved per ton of iron made. It is not unfair to take $6 per ton as the price of coke charged into the furnace. Then the saving in the use of hot gas will be (52 ÷ 2000) × $6 = $0.156 per ton of iron made for coke alone.

Flame Temperature. We have now to consider the flame temperature of this wet-washed gas, and then we are through with our discussion as to heat values. Let us assume the flame temperature to have a value between 2000 and 2400 deg. fahr. See Table 14.

TABLE 14 FLAME-TEMPERATURE CALCULATIONS

Constituent	Total lb.	Sp. ht. 2000° F.	B.t.u. per deg.	Sp. ht. 2200° F.	B.t.u. per deg.	Sp. ht. 2400° F.	B.t.u. per deg.	Sp. ht. 2380° F.	B.t.u per deg.
Carbon dioxide	2581.3	0.3100	800	0.3112	805	0.3340	860	0.3328	860
Nitrogen	4922.7	0.2643	1300	0.2667	1315	0.2691	1320	0.2688	1320
Aqueous vapor	165.4	0.6260	100	0.6466	105	0.6672	110	0.6651	110
Total			2200		2225		2290		2290

Dividing 5,425,520 respectively by the values 2200, 2225, and 2290 from that table gives 2460, 2450 and 2370 deg. fahr., and we may therefore accept the flame temperature at 2375 deg. fahr., the mean between 2370 and 2380 deg. fahr.

Curiously enough the flame temperatures of the dry-cleaned and wet-cleaned gases as discussed thus far are the same. Practical experience bears this out also, as Diehl's observations indicate that during reasonable test periods the combustion chamber temperatures are 2040 deg. fahr. on wet-cleaned gas and 2030 deg. on hot raw gas.[2] If the latter had been cleaned, our calculations show it would have had as high a temperature as wet-cleaned gas.

Our discussion on heat values of gas may therefore be summed up as follows:

1 Dry-cleaned gas at 400 deg. fahr. even if it contains 35 grains of moisture per cu. ft. has a greater available heat value than wet-cleaned gas at 70 deg. fahr. and 7.98 grains moisture per cu. ft. This heat is 6.5 per cent greater for the former gas than for the latter. At $6 per ton for coke charged into the furnace it means a saving of $0.156 per ton of iron made, in favor of using hot-cleaned gas.

2 There is no difference in flame temperature between the two gases.

Savings Due to Dry Cleaning

We have taken up at great length the question of net heat values of the gases. There are, however, many more factors to be considered in the discussion of wet versus dry cleaning. These factors will be dealt with only briefly at this time.

The costs of wet versus dry cleaning are of interest. If we take the cost of water to be 3 cents per 100,000 cu. ft. of gas cleaned we will be figuring below the average. Let this, however, represent the cost of cleaning the gas, as labor items will be alike for both wet and dry cleaning.

Now, in the dry-cleaning plant about to be described there is but one expense outside of labor, namely, the power cost. Since about 0.3 kw. is used per 100,000 cu. ft. of gas, if power is charged at 2 cents per kw., the cost of cleaning will be 0.6 cent per 100,000 cu. ft. of gas. This means a saving of 2.4 cents per 100,000 cu. ft. or 4.1 cents per ton of pig iron made.

It is, of course, impossible to calculate in dollars and cents all the benefits to be derived from the dry cleaning of gas, as there are factors on which accurate data cannot be obtained.

If, however, we consider the factors already discussed for which a money approximation has been developed, we find—

	Per ton pig iron made
Saving due to use of wet-cleaned gas in hot stoves over raw gas	$0.159
Saving in thermal value due to using hot clean gas over wet clean gas	0.156
Saving in operating dry over wet cleaner	0.041
Total calculable saving	$0.356
Estimated saving in using dry clean gas over wet gas in boilers	0.050
Estimated saving in hot-stove brick, boiler brick, etc	0.060
Total calculable and estimated savings	$0.466

When making 500 tons of pig iron a day, these savings become—

	Calculable	Estimated	Total
Per ton pig iron	$0.356	$0.11	$0.466
Per day (500 tons)	$178	$55	$233
Per year (365 days)	$64,970	$20,075	$85,045

We have then definitely calculated savings of $64,970 per year, not including increases in boiler efficiencies and increased life of boiler tubes, boiler settings, stove checkers and stove linings.

If we are willing to accept the estimated savings which the writer believes are conservative, then an additional $20,075 may be credited to the dry cleaning of gas as against raw gas. The total savings then are $85,045 per year. The calculable savings are about 60 per cent return, and the total savings about 80 per cent return, on the cost of a dry cleaner.

One other benefit to be obtained by dry cleaning is that there is no effluent problem. Two methods of handling the discharge of a wet cleaner are open to the operator. He may empty it into a stream, or he may recover a large amount of the sludge and discharge a more or less muddy effluent into the stream. In either case he discharges a nuisance. If the stream is polluted he may be restrained by law from killing, by cyanide in solution, anaerobic bacteria which digest the contamination and prevent its becoming a nuisance. If the stream is not polluted he may be restrained by law because of his being a public nuisance.

There therefore seems to be no brief for the wet washer as against the dry cleaner. Far-looking blast-furnace men have realized this for years. Some have had enough daring to pioneer for the dry cleaner, and to them belongs a large measure of credit for what dry-cleaner men have accomplished in the last few years.

Electrical Cleaners

The writer has in a previous paper discussed dry cleaners in general, and has given detailed descriptions of the electrical cleaners now in use.[1] Those who are interested in the details are referred to that paper.

There are now operating—or were before the steel industry had to take a vacation—two electrical cleaning plants.[2] These are commercial units which have been operating under as severe conditions as any cleaner can be subjected to. They have regularly been cleaning gases up to 900 deg. fahr. in temperature, under conditions of slip and subject to all the other irregularities of blast-furnace operation. Such difficulties as were first encountered, common to all new undertakings, were overcome long ago and one of them is now in its third year of operation.

Under the best conditions they have cleaned gas to less than 0.1 grain of dust content per cubic foot, and under difficult conditions to 0.4 grain per cubic foot. They have handled gases directly from the dry-dust catchers with dust contents varying up and down as is common in blast-furnace gas.

These cleaners are built on the electrostatic principle, and in sim-

[1] Poole's Calorific Power of Fuels.

[2] Proc. Am. Iron & Steel Inst., 1915, p. 318.

[1] Electrical Cleaning of Gases as Applied to the Blast Furnace, Phila. Section A.I.S.E.E., Nov., 1919.

[2] One at plant of American Manganese Mfg. Co., Dunbar, Pa., and one at Sheridan Furnace, Lavino Furnace Company, Sheridan, Pa.

ple form may consist of a single vertical pipe with a chain suspended through its center. This chain hangs from an insulator, while the pipe is grounded. The chain is connected to a mechanical rectifier, acting as a high-tension commutator and converting alternating current to unidirectional current. This high-tension alternating current is supplied at from 30,000 to 35,000 volts by a transformer built especially for this work. The current from the transformer is furnished through a switchboard from the plant power lines at single phase and low tension. Three-phase current is supplied to the synchronous motor operating the rectifier.

A full-fledged electrical cleaning plant contains a small substation in which switchboards, rectifiers, motors, resistance and transformers are located. This house may be elevated or not, as desired, and occupies but a small amount of space.

All the electrical equipment is installed in units. The high-tension pieces are thoroughly caged and the operator is guarded by interlocking electrical devices. Only low-tension equipment is available to him for operation when the current is on.

The cleaners themselves are of steel, vertically built in small cylindrical units filled with tubes and chains—one chain for each tube. They are compactly built and have a high structural factor of safety to withstand excessive temperatures.

Operating a cleaning plant is simple. Gas may be discharged into the cleaner under its header plate from which the tubes are hung. It will pass down around the outside of the tubes and up through the tubes into the top of the cleaner, thence out to the hot stoves and boilers. As long as the current is off this gas will be uncleaned. Now if the rectifier is put into operation so that it may be in shape to convert alternating to unidirectional current at high voltage, the single-phase current may be impressed on the transformer. The corona discharge will then take place from the negative electrodes to the pipes and cleaning will begin, and as there is no complicated mechanism to operate, an unskilled workman handles a whole battery of cleaners as they are controllable from one substation in which he is located.

When cleaning has proceeded for one-half to one and one-half hours, depending on the dust content of the gas, the current is taken off and the pipes are rapped. This causes the dust to drop to the bottom of the cleaner into the hopper devised for that purpose. At the end of the day the hopper may be emptied into a car or conveyor system as desired.

Since the tubes have a total cross-sectional area greater than the mains leading to the cleaners, there is no greater back pressure than is found in the mains.

The cleaners are rapped one at a time so that most of the plant is operative during the cleaning periods. To make rapping as easy as possible, automatically controlled and operated mechanisms have been developed to close the dampers, cut off the current, rap the pipes and chains, open the damper and put on the current intermittently and successively on all the units.

One man can handle a whole battery of cleaners as they are controllable from one substation in which he is located.

All this goes to make possible a departure from past experience.

* * *

In the discussion following the presentation of the paper the author, in reply to various queries, stated that 6 to 7 units of 8 ft. 9 in. diameter would be proper for a 500-ton furnace and that each unit contains ninety 6-in. pipes. The units operated from an hour to an hour and a half before they had to be stopped and the dust knocked down, dependent upon the condition of the gas. If the gas dirt came about 2 to $2^1/_2$ grains it would be necessary to rap only about every hour or hour and a half. The rapping only takes about 20 seconds and about one minute if done by hand. Precipitators are now designed to handle gas at 15 ft. per sec. In cleaning ferromanganese the dry cleaner does not get rid of all the manganese fumes; if manganese fumes were a true gas it would not catch this gas. On pig iron it cleans to less than one-tenth of a grain, and he was sure that it would clean to two-tenths of a grain regularly if properly designed.

Mr. Swann stated that based on his experience with electric furnaces at Anniston manganese fume was a true gas. He further stated that he was operating electric precipitators on phosphoric acid and obtaining 85 per cent clean-up and had had practically no trouble with the electrical part of the installation.

MODERN SHOP PRACTICE IN BUILDING REVOLVING FLAT CARDS

(*Continued from page 304*)

but are mounted on the ends of the spindles, one on each side of the machine. Large-diameter pulleys for driving the cutters are mounted directly on the outer ends of these spindles. This method of driving a milling cutter directly by means of a belt has been found very efficient inasmuch as it eliminates vibration and tendency to chatter caused by a gear drive, the belt producing a certain cushioning effect, and cutters thus driven require less frequent grindings and may be operated at a higher speed than those driven through a train of gears.

Power for driving the card is applied to the main cylinder shaft where a pair of 20-in. tight- and loose-webbed pulleys receive the belt. On the other end of the shaft an 18-in. pulley serves to drive the lickerin and flats. These pulleys require a considerable amount of machine work inasmuch as each is made with one or more grooves on one side for driving a round belt in addition to the crowned face. The outer sides of the webs are also turned. A special lathe, Fig. 13, was developed for doing this work by forming tools which carry cutters the full width of the surfaces to be finished. Special attention is called to the massive design of this machine, the headstock spindle being 16 in. in diameter. The heavy heads absorb all vibration even under the heaviest cuts. A special tool block is arranged for each operation, two of which are shown at the base of the machine, the one at the left being used for forming the web and rim, while that on the right blocks out the grooves and half of the crown, the other half being finished in a second operation by turning the pulley around. A spring chuck clamps the pulley securely in place while turning. This machine also carries a boring bar by which the hole is bored and reamed while the turning operation is going on. The average time for finishing the pulley shown at the left of the machine is 11 minutes.

The boring out of the ends of the lickerin shell also proved to be an operation which could not be readily or economically performed on a commercial type of tool and many of the milling operations on the various smaller parts of the card are such as to require the use of gang or form mills.

Coming now to the erecting room, the cards are set up here in rows of twenty-five each as shown in Fig. 14. They are completely assembled with the exception of the clothing and the flats and are then run off and carefully inspected before boxing. Dowel pins are provided wherever necessary so that the work of assembling at the mill is reduced to a minimum.

From the foregoing descriptions and machines which have been illustrated, there are several points to which attention should be called. First, the all-important problem is to get the actual labor cost per piece as low as possible, consistent with the high standard of quality required. This problem is somewhat different from that of most production shops where the low cost of production is arrived at by getting as large a production per machine per day as possible. Many of these special machines are capable of turning out two, three and even four times the amount of work required and are therefore often stopped from one-half to three-quarters of the time. It has therefore been found advantageous to arrange the machines in groups so that one man by operating the group will produce the amount of work required from the machines in his group.

Second, in designing the special machines it will be noted that extremely liberal dimensions have been allowed, and that the lathe and milling-machine spindles have been made to approximate as nearly as practical the diameter of the work to be turned, or the cutter carried by the spindle. In many instances these spindles are made of cast iron, running in bearings of the same material, the surfaces of which when glazed over are almost impervious to wear. The large masses of metal in these spindles and other parts have been provided so as to absorb all vibration and prevent any tendency to chatter even under heavy cuts and feeds.

Third, each machine is designed to do one or more operations on one special part and is suitable for no other purpose. Equipment of this kind is possible only where the product has been thoroughly standardized and is not subject to major changes in design.

Maintenance of Textile Machinery

Purpose of Ball Bearings and Importance of Proper Lubrication—Common Abuses and Suggested Corrections

By EDWIN H. MARBLE,[1] WORCESTER, MASS.

A MEMBER of a well-known firm of appraisal engineers recently stated that it was not practical to adjust values of textile machinery by any known annual depreciation percentages. Two machines placed in operation in different mills, receiving attention or lack of attention, will be represented on the valuation sheet by quite varying figures. It is the hope of the writer of this paper that some suggestion may be made that will bring the two valuations nearer together and assist in a better maintenance of the textile machinery that has been installed in so many of the mills.

While there is a difference in the character of the machinery used in the various processes incident to the manufacture of fabrics, the mechanical principles are the same, and adjustments or regulations are very similar for all types of machines.

We will take for specific illustrations that class of machines with which the writer is most familiar, namely, cloth-room machinery. The suggestions, however, will apply equally well to most of the machinery found in our textile mills. When machinery is being constructed by the builder, the frame is carefully leveled and the various bearings are adjusted and the machine when placed in its proper position on the mill floor should be carefully leveled and then securely fastened in its position. Several times we have had called to our attention a very careless carrying out of this suggestion. "The legs seem to be firm on the floor and the machine must be all right," was the report. This leveling is particularly important with machinery that has considerable length along the line of the main driving shaft, such as spinning frames, or with machines that have fine adjustments, such as shearing machines.

Having attended to this particular feature at the installation of the machines, it is well to repeatedly test out the stability of the leveling from time to time, particularly when the installation is in a new mill where the floors have not assumed permanency.

With the machine in position and various attachments and revolving parts in place, see that the bearings are not too snug and that each roll or shaft turns freely. We all expect a certain degree of stiffness in new machines and no matter how finely the builder may have made his fits, the transferring of the machine from one floor to another will have varied the adjustment to some extent, and a slight readjustment may be necessary.

With the machine starting off smoothly, what suggestions can we make to assist in maintaining its operating condition? Lubrication is possibly one of the prime considerations. Often it is no oil, an unstable oil, or a surplus of oil. The same oil cannot well be used on the high-speed spindle and the slow-revolving main shaft. The type of bearing may not be suitable for some of the heavy non-fluid oils. A regular system of oiling up should be practiced. Every morning the operator should see that any exposed oil holes are carefully cleared out and enough suitable oil applied to lubricate each bearing.

Oftentimes you will see on an automobile oiling chart, *A*, *B*, and *C* are to be oiled every five hundred miles; *H*, *K*, and *M* once in a thousand miles and by this means the maker of the auto endeavors to educate the owner in maintenance of his purchase. And more than that he specifies the quality of oil he thinks it best to use.

The textile-machine builder would like to furnish a similar chart and specify the grade or quality of oil, but the conditions under which his machines are used are so entirely different that it is not considered feasible.

However, requests for such charts have been received and it may be possible to construct such a chart at some later date.

On many textile machines, you will find ball bearings of various makes and they require considerable attention. First, we would ask why were these particular devices installed? Reducing all the answers to their lowest terms we find three reasons; they reduce bearing friction and save horsepower; they render good service by the saving of oiling troubles; or they were installed because some salesman convinced some one that he had a panacea for most of the ills mechanical devices are troubled with. The first answer is a rather limited one, for while the actual saving of horsepower is in many cases quite an item, the application of ball bearings to a particular revolving body should be considered carefully and the condition of working load examined and charted before any new installations are made.

In almost all cases the machine builder has looked the designing of his machine over pretty carefully before he has sent it out and is a fairly good judge of when and what kind of a friction-reducing bearing can be used to advantage.

Now regarding the second reason, which concerns the lubrication side of the ball-bearing question, any ordinary bearing must be oiled frequently. The installation of a proper ball bearing will in many cases reduce to a considerable extent both the time required to oil and the amount of oil used. The frequent oiling of ordinary bearings oftentimes breeds carelessness, and the surplus oil, conveyed to stock or fabric, produces damaged goods. This can be prevented in a great measure by a careful consideration of the application of a suitable friction or lubricant retaining bearing.

But don't for one moment think your troubles are ended when your ball bearing is installed. A ball bearing allowed to run dry can do as much damage as can any other type of dry-running bearing and perhaps from a financial point of view much more damage. We cannot attempt to tell how often a ball bearing should be repacked with suitable heavy oil or grease. The load under which it runs, the speed of the shaft and type of lubricant retaining washers or felt that is used, all have an influence on this. Three or four times a year may be necessary for one bearing, while another bearing can be allowed to run for six months without injury. But plainly speaking, every bearing must receive attention or your maintenance costs mount upward rapidly.

In the textile industry more than in any other, the ball-bearing salesman seems to have found a large number of gullible customers. Draft rolls on a cotton-brushing machine, approximately $1^1/_2$ in. in diameter, revolving 60 to 100 turns per minute, have been equipped with expensive self-alignment, self-adjusting, felt-washered, oil-retaining bearings, guaranteed to reduce the horsepower required to run the machine from 30 to 50 per cent. The large percentage of the horsepower required is consumed in drawing the cloth through the machine. The friction load on the bearing is very small and rarely have we seen any noticeable saving in power by such an application. On the other hand we have noticed on some machines ball bearings subjected to a heavy working load that have failed to stand up; due to not understanding the conditions or afraid to ask too high a price for the installation, the salesman had equipped the machines with bearings much too light for the duty required. Hence when in doubt about ball-bearing equipment on an old type of textile machine, ask the maker.

Many machines receive power in some of their parts, through friction clutches, and few mechanical movements have been subjected to so much abuse as have these devices. From a standing position you throw into action from $^1/_2$ to 10 hp., and expect an immediate response at approximately full speed. Promptness of action is demanded, yet little attention is given to the mechanism that must respond to the demand. The cone, or actuating part, is probably scored by the lever being too tightly pressed against it; as the clutch is handled the starting load is in excess of the best efforts of the friction band. Most clutches are designed to produce a pressure rapidly increasing toward the end of movement, yet the movement is often so rapid that the start is not made until the

[1] President, Curtis & Marble Machine Co., Mem. Am.Soc.M.E.

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extreme throw is completed. Through severe use the friction-creating surfaces are roughened so that instead of a gradually increasing friction application, the action is a grip or bite, demanding an immediate response on the part of the standing portion. Every application of the lever increases the roughness and necessitates more serious consideration of the remedy which eventually must be applied.

Give a little attention to the friction creating surfaces, cleaning them from gum or grease, smoothing any irregularities that may have been formed and particularly adjusting the toggle or connecting unit between the cone or actuating part. In fact, see that the clutch, as a whole, is in condition to respond to the call for its services. You are not dealing with a yielding movement like a leather belt, but rather a somewhat rigid device that depends on the frictional contact between two metallic surfaces for the transmission of energy—a splendid device when properly cared for, but usually one of the most abused attachments on any textile machine.

The moment any one says, "Use belting in a textile plant," some one else has his dissenting viewpoint. Every belt has to adjust itself in passing over a pulley, according to its thickness and flexibility. A stiff, thick belt on a small pulley is giving the operator about 60 per cent of the value of the proper belt. An overcrowned pulley of small diameter is another loss of power. Any piece of leather or perhaps canvas is good enough to transmit power, seems to be the idea of some of those in charge of textile plants, and one will find stiff and non-flexible belting being used to transmit power to a series of rollers running at a high speed and equipped with comparatively small pulleys. The result is that the belt will not conform to the arc of the pulley and hardly has time to straighten itself after leaving one curved surface before it must reverse its curvature in going around a second pulley. A pliable single belt of good quality will transmit more power and maintain more uniform speed. Then belts are often put on with little attention to conditions. The leather is stiff, dry and without flexibility and the belts are united by heavy hooks or plates, driven into the leather, with the ends probably not cut off square, so that the joint is irregular. Anything to get the machine started seems to be the policy, and yet every dollar saved by this poor method means several dollars lost in effectiveness of the machine.

Perhaps a final word will suffice about belt hooks, lacing, plates or other means of connecting the ends of belts. The nearer the joint is to the thickness of the belt and the more flexible its character the better.

How many machines are deprived of much of their usefulness by a disregard of the small things which enter into their construction. A thumbscrew may hold some attachment in position; it is lost and a piece of string or frequently a strip of cloth is used in its place. This makeshift is so inadequate that more or less loose motion continually takes place, and due to the resulting constant wear the attachment is soon either discarded or becomes inoperative. A cover is flopping about because some one broke the hinge or tore it from the wood or ironwork. Even a belt shipper is rendered unsafe by the wearing of the retaining section. We find shipper levers retained in place by a stick or block of wood and the discovery of this condition by a safety inspector prevented serious accidents in two cases known to the writer. "A stitch in time saves nine" can be applied to mechanical devices as well as to a pair of trousers.

Have any of you noticed the treatment which bearings receive in different textile plants? A driving shaft of suitable size has been installed on a machine by the maker. It is subjected to some hard usage, runs at a somewhat high speed and is carried in well fitted bearings lined with some anti-friction or babbitt metal. It may have been $1^{15}/_{16}$-in. diam. originally but neglected by the oiler eventually both the shaft and babbitt wear down and you have perhaps a $1^{13}/_{16}$-in. shaft running in an oblong hole 2 in. by $2^{1}/_{8}$ in. The result is a worn shaft wobbling around in a somewhat restricted space. At last the operator or foreman succeeds in calling a mechanic's attention to the condition and when the latter has time he takes out the shaft, removes it to the machine shop, finds it is out of round, turns it over to any odd size, takes off the bearings, knocks out the old babbitt and proceeds to rig up some blocking to rebabbitt. Without taking pains to center the shaft or to line up the bearings, he pours in his metal, chips off the surplus and repeats the operation on the cap to the bearing. He then endeavors to replace the bearing in its old position but not being true in alignment, he either packs up his bearing or the cap with cardboard or paper and finding he can turn the shaft in its revamped housing, goes off contented, "with other worlds to conquer" before him. Now this is not a notion or fiction, but has been found by the writer in more than one case. Let us suggest a plan of procedure. Turn your shaft to some special size, and carefully center the shaft in the bearings while they are in position. Then pack up under the shaft so as not to occupy quite one half of the bearing, pour your bearing, and repeat the operation with the cap, packing up the ears to the cap so as not to have a full half of the shaft in the cap. But remember one thing, the shaft that you use to babbitt the boxes in has been subjected to considerable heat. Take it back to the machine shop, true it up and then scrape your babbitted bearings to this straightened shaft until you have a good running fit. See that you have cut new oil grooves in both box and cap and on leaving your completed job, quietly suggest to the operator that a little more attention to lubrication would assist you indirectly.

Many of the incidents herein cited occurred during several recent visits of the writer to textile mills in the South and perhaps their presentation here will result in lessening the evils and abuses to which textile machinery is frequently subjected.

Hydroelectric Power Development on the Kings River, Cal.

One of the largest hydroelectric power development projects for which the Federal Power Commission has recently granted a license is that to be undertaken by the San Joaquin Light & Power Corporation on the North and West Forks of Kings River, Cal. An ultimate installed capacity of 266,000 hp. is planned, and if the present rate of growth in power consumption in the vicinity of the project continues, it is expected that it will be necessary to make the total capacity available by 1930.

The project, which will involve an estimated expenditure of \$51,000,000, will occupy about 14,000 acres of land in the Sierra and Sequoia National Forests. It will consist of three storage reservoirs designed to provide a combined storage capacity of 204,000 acre-feet; eight diversion dams ranging from 15 to 80 feet in height; and nine conduits of which 34 miles will be tunnel and one mile open ditch. Of the seven power houses planned, two will be built into storage dams and will operate under variable heads, the maxima being 175 and 245 ft., respectively; three will operate under heads of 365, 1420 and 1430 ft., respectively; and two, which will be among the very few plants in the United States operating under heads exceeding 2,000 ft., will operate under heads of 2,350 and 2,380 ft., respectively.

The main construction program is divided into five parts, for each of which the time of commencement and completion has been fixed subject to later modification with the approval of the Federal Power Commission, as follows:

Balch Development No. 1, May, 1922—June, 1924
Haas Plant, April, 1924—June, 1926
Kings River Plant, January, 1926—June, 1927
Balch Development No. 2, April, 1926—June, 1928
Farnham and Meyer Plants, April, 1927—June, 1929

Construction of the remainder of the project will be undertaken when market demands have grown to the extent which will warrant installation of additional capacity.

The developed power will be fed into the company's present transmission system through its substation at Sanger by means of a 110,000-volt transmission line to be built in two parallels, one of which will carry a single 3-phase circuit on wood poles, and the other, two 3-phase circuits on steel towers.

The entire development is covered by the license, but its provisions as to storage do not become effective until the corporation secures from the California department of public works the right to store water for power purposes. It now has the right to use the natural flow of the streams on which its diversion dams are to be built, except of Rancheria and Bear Creeks, tributaries, respectively, of the North and West Forks of the Kings River.

Extraction of Oil From Vegetable Matter

Together With a Description of the Operation of the High-Pressure, Yielding-Plunger Pump

By JOSEPH DAVIDSON,[1] ATLANTA, GA.

THE vegetable-oil industry in the United States has grown from practically nothing forty years ago, until today there are about 800 mills in the Southern States, producing oil from cottonseed, and about 100 mills in other parts of the country producing oil from various other oil-bearing materials, such as linseed, corn germs, peanuts, soya beans and copra.

The growth and importance of the vegetable-oil industry in this country may be judged from the facts that the present investment represented by the industry is approximately $200,000,000, and the normal amount of oil now produced annually is approximately 2,500,000,000 lb., requiring the crushing of approximately 5,800,000 tons of seeds and other vegetable oil-bearing material.

The methods and machinery used, while considerably improved, are much the same in principle as they were forty years ago. To some extent the oil has been extracted by the solvent process, in which the mass of ground oil-bearing material is treated with a solvent which dissolves the oil and carries it out of the material; the solvent is then evaporated from the oil and used over again.

There is also in use to some extent a machine for extracting the oil by forcing the material under great pressure through a slotted barrel by means of a rotating screw.

However, the great majority and the most successful mills are still extracting the oil by hydraulic pressure. In this method the cooked or tempered material is formed into oblong cakes with an outer covering of cloth by a cake-forming machine operated by hydraulic pressure. The oil is forced from the material through the cloth, thence through the perforations and slots of the press boxes, and is collected in a suitable receiving tank. The pressure used against the ram in the press cylinder is 4500 lb. per sq. in., which exerts a pressure of approximately 2000 lb. per sq. in. on the cakes of material being pressed.

It has been found that the manner of applying the pressure has a very important bearing on the efficiency of oil extraction, and also in the economy of the cloth used for covering the cake.

A high-pressure yielding-plunger pump has been designed and put into general use, and has proved to be one of the most decided improvements recently made. This pump applies the pressure in a manner which gives a greater efficiency in oil extraction and saving in press cloth than any yet obtained in the hydraulic method.

A simple low-pressure pump is also used with plungers having a constant stroke, working in connection with a weighted accumulator and by-pass valve, which maintains a pressure of approximately 600 lb. per sq. in. This supplies the pressure in large volume up to 600 lb. per sq. in. on all presses, and also supplies the pressure for operating the machine that forms the material into cakes, preparatory to being put into presses.

Referring to Fig. 1, the eccentric *A* imparts a reciprocating motion to the crosshead *B*. Yoke *C* is connected to crosshead *B* by means of two rods (one on either side, not shown in this figure) and moves fixedly with crosshead *B*. The two plungers *D* are fitted loosely, one in *B* and the other in *C*. Each plunger *D* has a collar *E* fitted against a shoulder. Between these collars *E* and the crosshead *B*, in one case, and the yoke *C* in the other, is placed a double-coil spring *F*, which receives the thrust of the plungers. The initial tension in the springs will stand a pressure of approximately 1800 lb. per sq. in. against the plunger without yielding, but when the pressure in the pump barrels *G* reaches 1800 lb. per sq. in., the springs will begin to yield, and continue to do so, more and more, as the pressure increases. Thus the stroke of the plungers is gradually reduced until the maximum pressure is reached, when they will cease to move; then the maximum pressure is held constant until the extraction of the oil is completed. The pressure is then released, and the cakes discharged from the press, which is then refilled for another pressing operation.

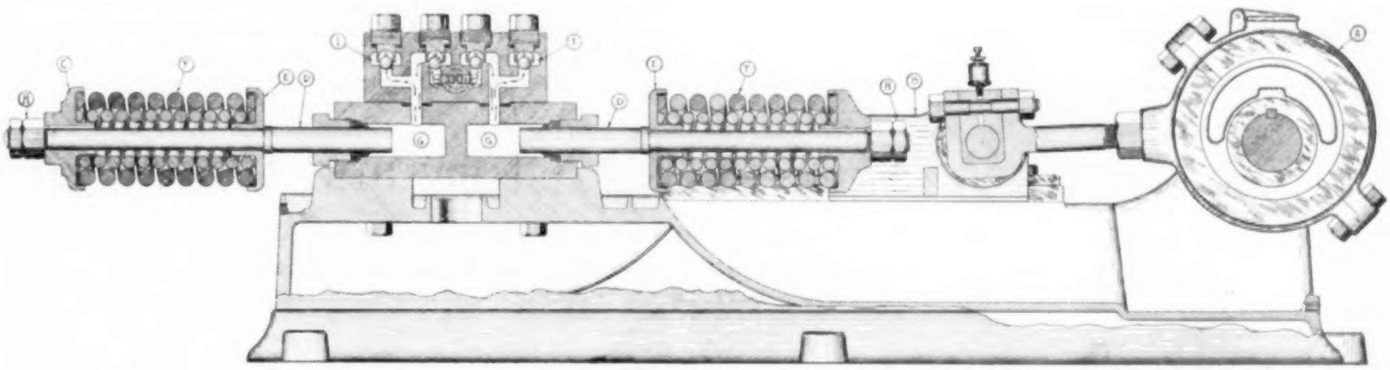

Fig. 1 Longitudinal Section Through High-Pressure Pump with Yielding Plungers

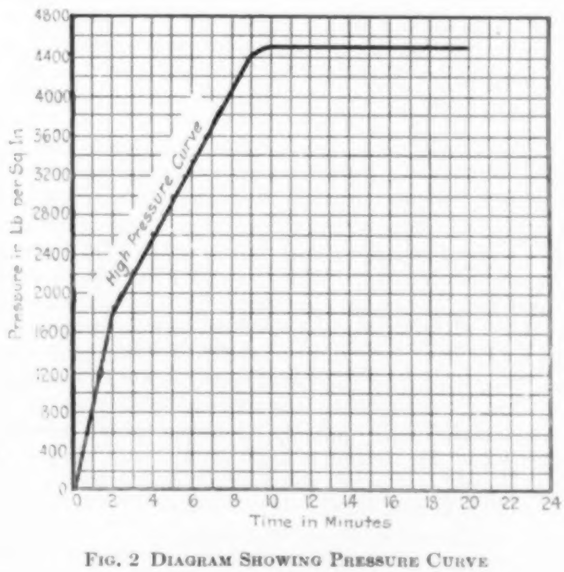

Fig. 2 Diagram Showing Pressure Curve

The pump can be set to maintain any maximum pressure desired, between the limits of 3000 and 5000 lb. per sq. in., by adjusting the nuts *H* on the ends of the plungers *D*. When this adjustment is once made, the plungers will continue to maintain

[1] Davidson & Kennedy, Oil Mill Engineers and Manufacturers. Mem. Am.Soc.M.E.

For presentation at the Spring Meeting, Atlanta, Ga., May 8 to 11, 1922, of The American Society of Mechanical Engineers. Copies may be obtained gratis upon request. All papers are subject to revision.

the same maximum pressure for a long period of time, without any further adjustment of these nuts.

Each chamber I around the discharge check has a $^1/_2$-in. discharge connection, and the common practice in applying pressure to vegetable-oil presses is to run a separate and independent $^1/_2$-in. pipe from each discharge connection to a press. Thus the high pressure on each press is supplied independently by one plunger, the pumps being constructed so as to provide one high-pressure yielding plunger for each press to be served. These $^1/_2$-in. high-pressure pipes are connected directly to each press cylinder, no valve being required to cut off the pressure. Each press is equipped with an inlet valve for low pressure and a discharge valve; also a check to prevent the high pressure from leaving the press cylinder through the low-pressure inlet valve. When the discharge valve on the press is closed, the high pressure is confined and builds up the pressure to the maximum required. The springs supporting the plungers are then in action, taking up the movement of the crosshead. When the discharge valve is open while the cakes are being discharged and the press boxes refilled, the plungers are moving full stroke and the springs are not being compressed; the volume of liquid being moved by these plungers merely circulates under no pressure through the press cylinder, and out of the open discharge valve, back into the tank supplying the liquid to the suction of pump.

The use of this pump in supplying pressure to the presses used in the vegetable-oil industry obviates the necessity for any outside controlling devices such as safety valves, retarding, or choker valves, etc.

The power required is the minimum for the amount of work being done. The peak load comes when the pressure reaches 1800 to 2000 lb. per sq. in., and while the plungers are still moving full stroke. But from the moment the plungers begin to yield, and the pressure continues to rise until it reaches the maximum, and the plungers cease to move, the power required decreases; so that the maximum pressure is maintained with little more power than is actually necessary to overcome the friction of the moving parts of the machine.

Fig. 2 shows the pressure curve obtained by this pump when the plungers are making 60 strokes per minute.

This constantly and gradually increasing pressure, especially above 1800 lb. per sq. in., secures the maximum oil extraction due to the fact that the density of the material being pressed is increased very slowly. This gives time for the oil to be forced out of the material, with the least possible resistance which would be set up in case the density was increased too suddenly by a rapid rise of pressure.

The minimum wear and tear on the cloth in which the material is folded is also secured, due to the cake's being much less distorted and exerting much less force against the unsupported parts of the cloth than is the case when the pressure is applied too rapidly.

The Southern Worker—His History and Character

How Industrial Life is Affected by the Development of the Cotton-Raising Industry; the Need for Vocational-Training Schools, Industrial Leaders and General Education

By FRANK H. NEELY,[1] ATLANTA, GA.

THE Odyssey of the southern worker is the story of his wanderings brought about by various economic and industrial changes that the South has undergone in the last one hundred or more years. The tale is picturesque in setting, emotional in action, and certainly inspiring in its present denouement.

Scattered loosely over a large territory, we find in the year 1800 many districts whose inhabitants are artisans, come over from England, Scotland, Ireland, Germany and Holland. These people were essentially of a manufacturing turn, and made of the South an industrial country, so much so, that up to 1810 the manufactured products of Virginia, the Carolinas, and Georgia were greater in value and variety than those of all the New England States.

This aspect continued until the invention of the cotton gin in 1793 by Eli Whitney which changed the whole face of the picture. Almost immediately cotton raising proved of such profit that all manufacturing was stopped and the artisan had in reality "lost his job." He was not an agriculturist, but wanted a high wage for a new pursuit which he was not able to control because of different training and lack of sufficient numbers. Cotton raising was so profitable that it behooved the southern planter to acquire all the land and slaves he could, as cotton brought over twenty-five cents per pound during the next forty years. The artisan was forced by this development to move farther back away from the plains, which were highly suitable for cotton raising, toward the mountains, where he formed a social group, with manners and customs of his own. He made now only the articles that he needed for the use of his family, for the slaves were taught all the homely arts that were needed for life on the plantations.

By 1860 these people were thoroughly settled near the foothills of the Blue Ridge where they became small farmers raising some cotton and grain, and carrying on small trades.

The call to arms in 1861 was answered not only by the men, but also by all boys who had reached the age of sixteen. After the four years of struggle, the man power of the South was depleted, plantations devastated and neglected, railroads torn up, bridges wrecked, the whole country, battle-scarred and desolate. Men straggled back to towns that were no more, living was precarious; men were broken in body and spirit, and their land and tools in no condition for the resumption of work.

Among those who formerly were in condition to help the less fortunate there was scarcely any difference, for the whole economic and social structure had been upset by the abolition of slavery.

The emergence from this condition was necessarily slow. The transition from an agricultural country employing slave labor to one semi-agricultural and manufacturing was difficult, and the years 1865 to 1872 were unfruitful in the development of manufacturing establishments.

However, one by one, cotton mills were built, and once more these artisans of the years before slavery came into their own and began to be what they now are, the foundation of the cotton-mill industry.

These first mills, then, and their builders were heralded at that time as the saviours of widows and children, who were largely without means of support, and the editorials of the day lauded the enterprise of these men and looked upon their activities as a godsend to the South and its population.

The Southern Worker

The characteristics of the industrial workers of the South make them at the same time good and bad factory artisans. Living largely in the mountains and by means of their own devices, they have had only such necessities of life as a poorly managed and fertilized farm would yield. Having no educational advantages, they are ignorant, in many cases illiterate; having for generations lived to themselves, they are sometimes unmoral, seldom immoral: but preëminently, because of their ancestry, they are proud. To some extent their word can be depended upon. They have common sense and are generous to a fault, yet their prejudices will sway them at times to unreasonable ends. They are improvident and wasteful, yet understand basic principles of business because of actual experience on their farms, which has taught them that they who do not produce cannot eat. It is easy for them to understand that a business may fail, because many times their crops have failed.

[1] Industrial Engr., Fulton Bag and Cotton Mills. Mem. Am.Soc.M.E.

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They are of a mechanical turn of mind because of the necessity through generations of shoeing their own horses, sharpening their plows, and doing carpentry work around their own homes and those of their neighbors.

When properly approached and when they are not distrustful of their leaders, they are easy to stimulate. From the time when their mode of life dated back to the period when they felt a certain aristocracy due to slavery surroundings, following through to the present day, they developed a sort of cult, and one must understand not only their present conditions, but also the conditions generations back to comprehend fully their frame of mind and overcome their strong prejudices. Their lack of training of hand and mind makes them difficult at first as factory workers, but their knowledge of the English language makes them, *when trained*, a group of the most satisfactory and able artisans.

Every point of leadership must be exerted to encourage the untrained and unlettered worker to exercise the proper effort for accomplishment. Response is not quick, but when once trained, he develops skill and ability, which added to his native *stability*, enables him to outclass in many cases the workers of other sections of the country. Manufacturers of the South have never understood that pride in artisanship is one of the prime moving forces of the southern worker. Moreover his home training has developed his respect for authority; he has lived in a patriarchy, in which the whole family follow the laws laid down by the father.

Eastern Immigrant Labor

When, then, the Southerner comes to work in a factory, he already has that respect for authority which is lacking in the immigrant worker who has come to America only recently; searching, expecting, and demanding freedom from every American institution, national and local, civic and commercial. The newcomer ignores the voices of his parents who have not yet learned our language and our customs, and he totally misunderstands the symbolism of the Statue of Liberty.

Foreign workers in New York, Boston, or Philadelphia, make of the factory a veritable tower of Babel, speaking various languages, unimpressed with the fundamental principle that they who would eat must work, failing to realize that the "tools belong to the hands that can wield them." They cannot be made to see that production is the source of all wealth and that buildings and equipment are of no avail unless properly organized to produce. They cannot be made to understand the parallel between the idle farm and an unproductive factory. Deceived at times by unscrupulous management, they are skeptical and distrusting, so that a satisfactory understanding with them is difficult. They are suspicious of authority, and are continually looking for injustices. Such a frame of mind constantly aggravates actual conditions. The result is an unstable working force, difficult to control. There are continual demands of unreasonable individuals; there are high training costs brought about largely by lack of understanding of the instructions given by English-speaking foremen to the many-languaged workers.

Middle-Western Workers

In St. Louis and New Orleans we find conditions which make for better factory control as there is a stability which is due to the predominance of German and French elements. These people have been in these sections of the country for more than a generation. They have learned confidence in the constituted authority of the Government and therefore in the constituted authority of organization. They can speak the language, and are more energetic and better educated and more intelligent than the southern worker. They take training quickly in particular trades, yet their stickability is somewhat less than that of the Southerner.

The control and operation of plants in widely separated sections of the country present, then, problems of management that involve not only the differences of the men in control, but also present the differences of the individuals and the characteristics that make up the *working force*.

When we were training an army we had discipline born of military necessity. The rapidity of the training depended on the ability to discipline the soldier regardless of his type, or the locality of the training camp, and on enforced uniform methods.

If uniform results are to be secured in factory organizations, certain well-defined methods of control must be practiced. Not having the absolute power of the army, our discipline must be built on leadership, fair play, and the necessities of the plant as a whole. All workers must be judged by their performance, as shown by fair, equitable, and scientifically set standards.

When the Gantt methods began years ago to point the questioning finger at our many organizations throughout the United States, they inspired the campaign for facts, which facts every honest factory manager had to answer sooner or later. The eternal question of why the fall-down, if honestly answered, placed the responsibility upon the managerial control of the plant, and in most all cases showed that the worker was the scapegoat.

Good Management Essential

The answer always lay in planning, scheduling, disciplining, and training. The most important of these elements of good management as we view the many kinds of people in the various parts of the country, is training. It is comparatively easy to plan the work in New York or to schedule a factory's operations in San Francisco, but the accomplishment of such plans and the carrying-out of such schedules is absolutely dependent upon the training, discipline, and control of the organization wherever located.

During the most trying period that the productive forces of industry have ever passed through, our experience has proved that equal results *can* be secured regardless of the locality of the factory or the type of the worker. We further know that such results only come with the proper training and that such training is only possible when all favoritism is eliminated from an organization and well defined principles of discipline are insisted upon among our superintendents.

The South needs training schools to teach all arts. Having been raised through the generations to do things in a crude manner, no artisanship has been taught to the mass. The South needs leaders in the management of every industry. Specific and scientific methods of training and scientific methods of carrying on operations must be developed. The worker cannot train himself—he needs help—he needs instruction, and must have it.

Industrial leaders must be furnished by our technical schools. General education must be made available for the majority, so that the South may take its just place in the industrial world.

American Labor as Viewed by a British Business Man

B. Seebohm Rowntree, a well-known business man and a director of the Industrial Relations Department of the British Munitions Bureau during the war, is of the impression that on the whole an unskilled man emigrating to American today improves his condition. If he is a Britisher his real wages in the new country may not be better than in the old country, but he has a better chance of promotion. An immigrant from Eastern Europe receives more money immediately, and in addition to that has a chance of progress. The skilled worker in America is decidedly better off than a man in similar position in England.

There is more "push," youthful enthusiasm, willingness to take chances in American business than the author found in England. Hand in hand with this goes, however, as he points out, the fact that the American employer is on the whole a better administrator than the English one. He is more alert, more critical of his methods, and quicker to adopt improvements.

The author was particularly impressed by the excellent research work which was being carried on in America, and, as an example, he cites the case of the laboratories of the National Electric Light Association in Cleveland, about which he says that as he came away he felt that no country that is not determined to make the widest possible use of science can long hope to remain in competition with America.

As regards the situation in the labor organizations, the author is a good deal less enthusiastic. He is inclined, however, to blame the employers, who he claims are adopting the same attitude toward the unions as the British employers did 30 or 40 years ago, and, in his opinion, will have to pay for their mistake by years of labor unrest.—*The Century Magazine*, April, 1922, pp. 944–949.

SURVEY OF ENGINEERING PROGRESS

A Review of Attainment in Mechanical Engineering and Related Fields

The Still Engine

THE Still engine which was first described in a paper by Frank B. Ackland before the Royal Society of Arts in May, 1919, is a combination of internal-combustion engine of the high-compression type and a steam engine. It is being developed by the Still Engine Co., London, and its licensee, Scott's Shipbuilding and Engineering Co., Greenock.

Extensive tests have been carried out on this engine—in particular, those lately conducted by Capt. H. Riall Sankey, former president of the Institution of Mechanical Engineers. Besides its main feature of combining an internal-combustion engine and steam engine in which steam generation is a by-product of the main engine operation, in the Still engine steam is utilized for cooling the piston, and as a certain amount of superheat is added to the steam during that process, the efficiency of the steam cycle is thereby improved. Also, by burning oil in the regenerator, steam may be used for starting and maneuvering.

The experimental engine described in the present article, known as the Scott-Still engine, was built to cover a range of power varying from about 700 to 7000 b.hp., and has cylinders 22 in. in diameter and 36 in. stroke. Such an engine running at a speed of 120 r.p.m. was estimated to give a normal brake horsepower of 350 in one cylinder and an overload of about 400 b.hp.

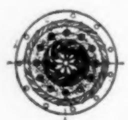


FIG. 1 COMBUSTION-CYLINDER RIBBING, STILL ENGINE

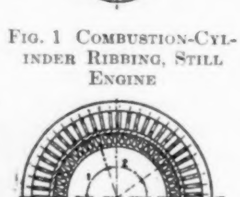


FIG. 2 PISTON-HEAD RIBBING, STILL ENGINE

The crankshaft and the bed plate were designed so as to be suitable for six cylinders of this size in line. As however, it was considered desirable to work the experimental engine on the compound principle on its steam side, so that its working condition might approximate as closely as possible those which will obtain in a multi-cylinder engine on board ship, a small independent single-acting high-pressure steam engine with a cylinder of 14 in. diameter and 22 in. stroke was also constructed and coupled direct to the main-engine crankshaft. The cranks of the two cylinders are arranged at the same angle relative to the dead centers so that the pistons move up and down together. By this arrangement the steam side of the main or combustion cylinder which forms the low-pressure stage is ready to take steam just as the high-pressure cylinder begins to exhaust. The steam side of the main cylinder is 180 deg. of crank angle behind the oil side, so that the engine is double-acting in its operation with this limitation, however, that the power developed on the steam side is considerably less than that developed on the oil side.

Cylinders are provided with liners, which, in this case, are only $^5/_8$ in. thick in the body (see Fig. 1).

The main idea underlying the design of the Still engine liner is the reduction of the temperature differences and consequent heat stresses between its inner and outer walls to the lowest possible minimum, and the provision of ample surface for the rapid transfer of heat to the jacket water. The whole combustion load is taken by the breech end of the liner, and transmitted through the conical joint to the large steel bolts. There is no cylinder cover on the engine in the sense in which a cover is understood in oil-engine practice.

The steam and the exhaust valves, of which there are two and four, respectively, of simple piston type, are carried well on to the cover head to reduce the steam clearance volume to a minimum, and are directly connected to their operators bolted on to the cover flange. In this connection it should be understood that the combustion and steam cylinders are rarely component parts of the whole with a common piston.

The piston is made in two parts. The skirt calls for no remark, but the head is spirally ribbed internally as shown in Fig. 2, to guide the flow of steam over the crown in as long a path as is reasonably possible. At the same time this formation provides the piston with some degree of flexibility and allows it to adjust itself to temperature conditions without danger of fracturing the ribs. The piston rod is deeply embedded in the piston head with spigot and flange, and the attachment of the two is made by studs and nuts. The piston head is pierced by six holes for the guidance of the steam to the piston head, and is enlarged in diameter at this part to maintain its strength. These holes, acting in conjunction with the steam valves and ports, convey the steam during the admission period into the cylinder by way of the ribbed space on the under side of the piston head, heating the steam and cooling the head, to the manifest advantage of both.

The piston-rod crosshead is of special design. It is well known that the crosshead bearings of most types of Diesel engines are very heavily loaded and frequently give trouble from that cause. In the Still engine, although the load is naturally reduced because of the cycle, the crosshead has been designed to still further reduce the load, and to insure cool and easy working under all conditions. The design adopted admits of the length and diameter of the pin on its underside being available for the downward combustion load. On its upper side the pin is secured to a saddle, which takes the half-bearings for the upward steam load. This saddle is bossed, and provides for the attachment of the complete crosshead to the piston-rod by cotter. In this construction the top and bottom bushes work on different bearing diameters, but these being concentric, no real objection can be taken to the design on this account, and in practice the whole bearing works satisfactorily.

As regards the valve gear when the engine is running, the only valves in operation are the fuel-injection valve on the combustion side and the steam-exhaust valve on the steam side. The former is worked automatically by the fuel,-injection pressure and the latter by oil under pressure. The fuel-injection pump has a solid plunger $1^1/_4$ in. in diameter with a stroke $^1/_2$ in. fitted to the pump barrel without backing. The timing of the fuel injection is fixed by the fuel cam and the period of injection by a spill valve. (The interesting operation of this spill valve is described in the original article.)

The oil-pressure system for operating the steam inlet and exhaust valves is such as to eliminate all layshafts, eccentrics and similar mechanism. Its operation is shown by Figs. 3 and 4 and is, as follows: A simple plunger type of pump worked from the main shaft supplies oil at a pressure of from 350 lb. to 450 lb. per sq. in. to the valves to be operated. The oil passes from the pump through a distributor worked by spiral gearing from the main shaft. Separate distributors are provided for the steam inlet and exhaust valves. These are shown in Fig. 3 at *A* and *B*, and sectionally in *C* and *D*, Fig. 4. The ports are so arranged in the cylinder and piston that once per revolution they register and give an impulse to the column of oil between them and the valves, thus opening the latter. An operator directly connected to each valve is interposed between this volume of oil and the valve, to receive and transmit the impulse. It is under a constant pressure of oil direct from the pump on its upper side, and is subject to an intermittent impulse pressure load on its under side. As soon as the impulse load is released the constant pressure closes the valve. The operator on its under side is of greater area than on its upper side, and this difference gives the upward load required to open the

valve when the ports which are used for operating the steam inlet valves to give a late cut-off when starting up the engine. This exhaust and starting distributor is fitted with a shuttle valve which is set by oil pressure for ahead and astern running. The steam inlet, on the other hand, is provided with a slipping arrangement on the plug coupling for this purpose.

The oil-pressure system is used also for starting up the engine and for maneuvering. During these processes the oil-pressure supply is obtained from an independently driven stand-by pump. The regenerator is a small boiler of 150 lb. working pressure, 5 ft. 6 in. in diameter and with 300 sq. ft. of surface.

In starting from cold the burner under the regenerator is lighted and steam is raised as in an ordinary boiler. The engine may be

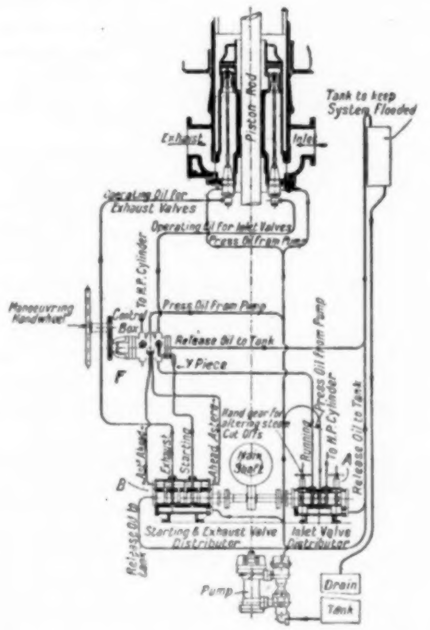


Fig. 3 Diagram of Oil Valve-Control System

kept running on steam alone for any desired length of time, or fuel may be cut in as soon as it becomes warmed up, and the engine brought up to the required speed. The cutting of the fuel is accomplished simply and easily by means of the governor or hand-lever control acting on the spill valve above referred to.

Tests were made to determine the weight of steam generated in the experimental unit. The quantity of steam generated from waste heat by the single cylinder is 800 lb. per hr. at 120 lb. pressure per sq. in. when the combustion cylinder is working with about 80 lb. mean pressure equal to a normal load of about 340 b.hp. It increases as the load is increased and falls away as the load is

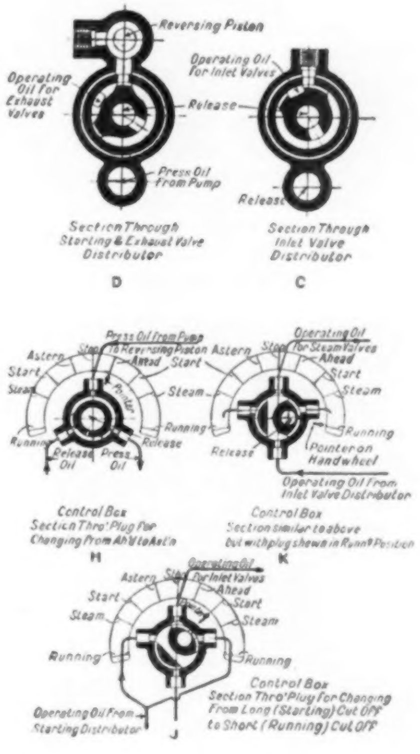


Fig. 4 Diagram of Oil Distributors

reduced, until at about 35 lb. mean pressure in the combustion cylinder just sufficient heat is being recovered to equalize the radiation losses.

The preparation of power obtained from the steam side amounts to about 12 per cent of the total horsepower at full normal load. This applies, however, only to the single-cylinder engine and from 15 to 20 per cent are expected from the multi-cylinder engine. Extremely interesting data of tests are reported in the original article which cannot be abstracted owing to lack of space. (*The Engineer*, vol. 133, nos. 3451 and 3452, Feb. 17 and 24, 1922, pp. 180-182 and 204-207, 20 figs., *deA*)

The Manufacture of Iron and Steel Tubing and Pipe

By EWALD ROEBER

All iron and steel tubing and pipe may be divided into two main classes; viz., A, those with a longitudinal seam, and B, those without a longitudinal seam (seamless tubing).

There are quite a number of processes for making tubing and pipe in each of the two classes. The author considers the various processes, with the exception of cast pipe. Welded pipe is made now practically exclusively out of mild steel and no longer of wrought iron. The most important processes (*Verfahren*) for the manufacture of welded pipe are as follows:

I Butt welding by drawing
II Lap welding by rolling
III Water-gas welding
IV Autogenous gas welding
V Electric welding.

Seamless tubing is made practically exclusively from ingot steel by the following main processes:

VI Cross-rolling and rolling in pilgrim rolls (Mannesmann process)
VIIa Piercing-press and draw-press process (Ehrhardt process)
VIIb Piercing press and draw press for larger sizes
VIII Cross-roll piercing and continuous rolling
IXa Cross-roll (disk) piercing (Stiefel process) and duo-rolls (Swedish rolls)
IXb Press pointing, press piercing and duo rolling
IXc Press piercing (Ehrhardt) and duo rolling
IXd Cross-roll piercing and duo rolling.

In addition to these the following process is used for the manufacture of tubes of large diameter and comparatively short length:

X Press piercing, press drawing and rolling on special rolls.

The processes of manufacture of butt-welded pipe by drawing and lap-welded pipe by rolling (I and II) are the oldest by which pipe has been manufactured.

The material used in making welded pipe comes in the form of skelp, of which the length, width, and thickness correspond to the length, diameter, and wall thickness of the finished pipe. For the manufacture of seamless tubing, the material comes in the form of solid billets of round or rectangular section, those for the smaller sizes being rolled previous to piercing.

In process I of welded-pipe manufacture the skelp goes first to the cold shears where it is beveled on the edges and, to a certain extent, shaped. From the shears it goes to a furnace heated by coal or producer gas and is there brought to a welding heat. The white-hot skelp is gripped by tongs and drawn through a bell-shaped die in which it is simultaneously bent to proper pipe shape and butt-welded. First, before the skelp enters into the bell die the edges are subjected to a blast of compressed air, the purpose of which is to clean them of slag and raise the temperature so as to facilitate the welding. With this arrangement it becomes possible to complete the welding of pipe in one draw, i.e., in one heat. The welded pipes then go to sizing rolls where they are brought to proper dimensions; from these they go to straightening rolls, the purpose of which is indicated by the name, and thus, final shaping of ends and inspection.

In process II, lap-welded pipe, the preheated skelp goes to special rolls where its edges are beveled, and then it is passed on the same

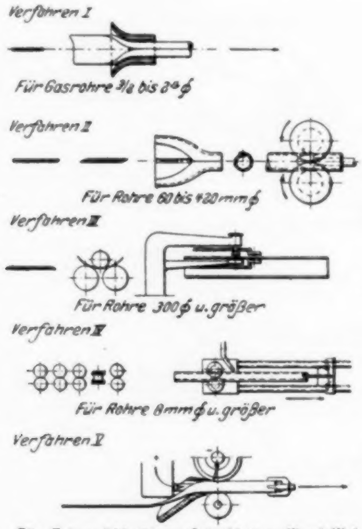


Fig. 1 Various Processes for the Manufacture of Welded Pipe
(For particulars see text.)

heat through the bell die and shaped into a tube. This tube with the edges apart is sent again, while still warm, to the heating furnace where its temperature is raised to welding heat. From the furnace the tube goes to the welding rolls where the actual welding is done. The larger sizes of pipe are bent to tubular shape not in bell dies but in plate-bending machines, from which they likewise go to the reheating furnaces.

To some extent pipe may be made complete in one pass in the weld-heating furnace. As a rule, however, from two to three reheats are necessary. The welding rolls consist of a pair of grooved rolls in which the tubes are rolled over a mandrel which is supported by a long, strong bar. Lap-welded tubes after welding have also to be passed through sizing rolls, straightening rolls, etc., like butt-welded pipe.

In the water-gas welding process of pipe manufacture (process III) only the edges of the skelp are brought to welding heat. The skelp is beveled in beveling machines and then bent to pipe shape on plate-bending machines, this bending being carried out either in the cold or in the hot state, depending on the diameter of the pipe and its wall thickness. The pipe is then brought, spot after spot, to welding heat by a water-gas torch inside and out and welded over an anvil by steam, compressed air, or hand hammer. In some instances hydraulic pressure is employed instead of hammering. This kind of pipe comes out from the welding smooth and even. In processes IV and V (autogenous welding and electric welding), as in the previous process, only the welding edges are heated; in process IV, acetylene or hydrogen are used practically exclusively.

For producing seamless tubing on the Mannesmann cross-rolls and pilgrim rolls (process VI), it is necessary to start with solid round billets. These are preheated in a coal- or producer-gas-fired furnace, pierced on the cross-rolls and drawn out into long tubes on the pilgrim roll stand. In the case of pipes of more than 300 mm. (11.8 in.) diameter it has been so far necessary to put the billet through the cross-rolls twice, although there are new installations in which these tubes can be pierced in one pass. The tubes from the pilgrim roll stand are usually brought to the right size on draw benches or sizing rolls.

In process VIIa, press piercing and press drawing (cupping), square-section billets are used. These billets are preheated in a furnace and then pierced in a press in such a manner, however, that the hollow billet retains a solid bottom. The hollow block is then (on its original heat) put into a long horizontal press and mandrel attached to the press plunger is fixed into the billet which is then forced under pressure through a series of consecutively placed dies, and thus drawn out into a tube. Process VIIb is substantially the same as VIIa, only instead of having the dies in the draw press located consecutively one after another, the billet with the mandrel inside is passed through a single die, then drawn back and the die replaced by a smaller size, after which the process is repeated.

The cross-roll piercing and continuous rolling process (VIII) at the outset is like process VI with solid round billets, which are pierced in the cross-roll stand and on the same heat put over a long mandrel and sent through a set of consecutively located pairs of rolls, of which there may be seven. In processes IXa to IXd, inclusive, various special devices are used for piercing a solid block, but the duo rolls are used in all of them for rolling. For the Stiefel process (IXa) and for process IXd round billets are used, while for processes IXb and IXc square-section billets are preferred. The Stiefel stand is essentially similar to the Mannesmann stand, but is used for producing thinner-walled tubing than the Mannesmann.

In the piercing press of process IXb a mandrel is pushed through to the middle of the billet from both sides after which the billet thus pointed is put on a piercing press and there pierced entirely by a bigger-size mandrel. In the piercing-press operation in process IXc the square-section billets are pierced through by a single mandrel exactly as in processes VIIa and VIIb, but the hole goes clear through and no solid bottom in the billet is left. The hollow billet from the presses in all of these four processes goes to the duo rolls on its own heat. The duo rolls consist of several sets on which the hollow billet is rolled into a tube over a plug. The plug lays here in a groove between the two rolls and is supported by a bar located behind the rolls.

The stand in this roll is from 1.2 to 1.8 m. (47 to 70 in.) wide and contains a number of flat rolls placed side by side.

For some time now the practice has been to send the pipe coming from the duo rolls through finishing rolls to give it a smooth surface and possibly to size up closer the wall thickness. From the finishing rolls the pipe goes through sizing rolls, then straightening rolls, and after passing through anneal, on to inspection. Process X is the well-known Ehrhardt process for making large seamless hollow bodies. Billets are hollowed out in big presses similar in character to those employed in processes VIIa and VIIb, i.e., with solid bottoms (cupping process), and then further drawn in big cupping presses, after which the bottom of the cup is cut off and the hollow billet rolled in a special mill in which there are rolls inside and outside of the billet.

Figs. 1 and 2 show diagrammatically the essential features of the various processes (*Verfahren*) of manufacturing welded and seamless iron and steel tubing and pipe.

In Germany butt-welded pipe is made in sizes of up to 60 mm. (2.36 in.) in diameter and abroad in sizes up to 3 in. The wall thickness varies from 2.5 (0.1 in.) to 4.25 (0.16 in.) mm. for gas pipe, and 2.75 (0.108 in.) to 5 (0.19 in.) mm. for steam pipe. Pipe by this process is made in lengths of 5 to 6 m. (16 to 20 ft.). Lap-welded pipe by process II is not made by welding rolls in sizes less than 60 mm. (2.36 in.) outside diameter. The usual range for such pipe is 60 to 420 mm. (2.3 to 16.5 in.) although abroad such pipe is made in sizes up to 520 mm. (20.4 in.). With this process there is no trouble in making pipe of standard thicknesses for boiler use. and pipes with thinner walls can be also made without trouble. Such pipe is made in lengths up to $7^1/_2$ m. (25 ft.).

Pipe welded by water gas (process III) is made with diameters

starting from 300 mm. (11.8 in.) and can be made in thicknesses up to 90 mm. (3.5 in.) and lengths up to 8 m. (26 ft.). Gas- (acetylene or hydrogen) welded pipe (process IV) can be made with diameters from 8 mm. (0.3 in.) up to the largest desirable, and in wall thicknesses from 0.5 mm. up to 10 mm. (0.019 up to 0.39 in.). Pipe in sizes from 8 to about 120 mm. in diameter (0.314 to 4.72 in.) and in length up to 9 m. (26 ft.) is made on special automatic machines. Larger sizes of pipe are welded by hand, and in such cases the length of the pipe is practically unlimited. The range of electrically welded pipe is the same as that of gas pipe. It must

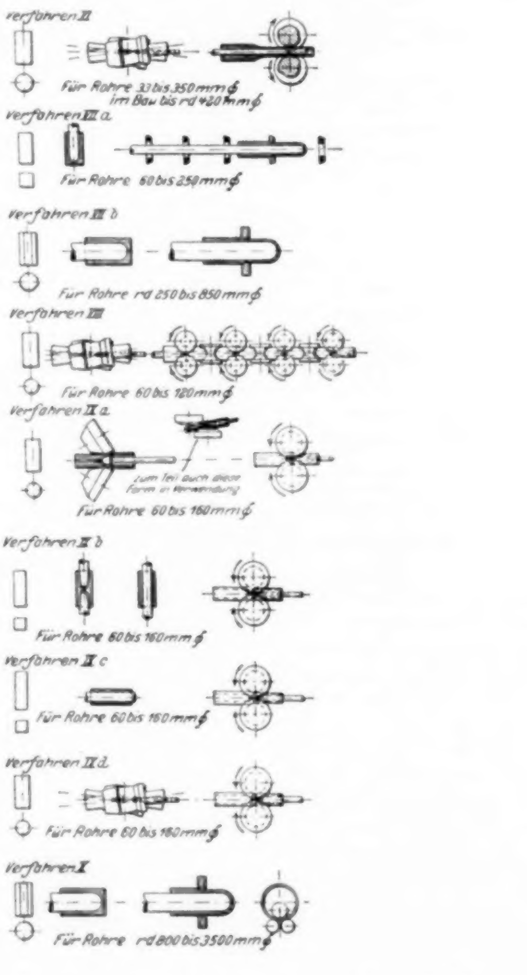


Fig. 2 Various Processes for the Manufacture of Seamless Tubing
(For particulars see text.)

be noted, however, that its development has not progressed as far as that of the other methods in Germany, and it is only quite recently that methods have become known there for welding such pipe in wall thicknesses under 1 mm. (0.039 in.).

As regards seamless tubing, the Mannesmann cross-roll and pilgrim-roll process (VI) gives pipe from 35 to about 350 mm. (1.3 to 15.7 in.) outside diameter with wall thicknesses of boiler-tube standard as a minimum, i.e., $2^1/_4$ to 9 mm. (0.08 to 0.35 in.). This kind of tubing is made chiefly in double lengths of 12 to 15 m. (0.47 to 0.59 in.). Longer tubing, however, can be made by this process.

By the Ehrhardt cupping process (VIIa) the smallest tubes made are 60 mm. outside diameter (2.36 in.) and the largest up to about 250 mm. (10 in.), but pipe with wall thicknesses less than 3 mm. (0.12 in.) have not been made here. Process VIIb is a very modern development. By it pipe is already made with outside diameters up to 850 mm. (33.5 in.) and lengths up to $5^1/_2$ m. (18 ft.) with wall thicknesses of about 150 mm. (6 in.). Process VIII permits making pipe from 60 mm. to 120 mm. (2.36 to 4.72 in.) diameter and processes IXa to IXd, inclusive, pipe from 60 to 160 mm. (2.36 to 6.3 in.). In all of these processes the wall thicknesses range from about 3 mm. up to 15 mm. (0.11 to 0.59 in.), while the lengths vary from 7 m. to, say, 10 m. (23 to 33 ft.). Process X permits the making of tubular bodies from 800 mm. to 3500 mm. (31.4 to 138 in.) in diameter with wall thicknesses ranging from 10 to about 150 mm. (0.39 to 6 in.). The original article gives a diagram showing these various dimensions.

A comparison of the various processes for the manufacture of seamless tubing shows that for tubing in excess of 160 mm. (6.3 in.) in diameter and in lengths up to 6 m. (20 ft.) the Mannesmann process (VI) and processes VIIa and VIIb may be used, while for lengths in excess of 6 m. (20 ft.) the Mannesmann process alone is available. Tubing with diameters smaller than 60 mm. (2.36 in.) likewise tubing with wall thickness of less than 3 mm. (0.118 in.) have to be finished on hot or cold draw benches. (*Stahl und Eisen*, vol. 42, no. 7, Feb. 16, 1922, pp. 253 to 258, 5 figs., *dA*

Short Abstracts of the Month

AIR ENGINEERING (See also Internal-Combustion Engines)

BUREAU OF STANDARDS (See Varia)

FUELS AND FIRING

Anthracite Briquetting in Canada

Briquetting Anthracite Fines with Crude-Oil Residuum. Description of the briquetting plant of the Nukol Fuel Company, located at Port Stanley, a few miles from London, Ont., Canada.

The first step in briquetting is to free the raw coal of excessive moisture, which must not exceed about 2 per cent in the final product. In this case this is done by a drier of the single-shell rotating type, 6 ft. in diameter and 40 ft. long. The receiving end projects into a Dutch-oven type of furnace, located directly beneath the wet-coal bin. The coal is delivered to the drier from the bin in a measured flow by means of an apron conveyor and a cast-iron chute passing through the roof of the furnace. The flow of coal is accurately controlled by means of an adjustable gate which permits the regulation of the moisture content. The coal passes through the drier in contact with the hot gases, and when dry is carried away by means of a spiral conveyor and bucket elevator into a bin at the top of the building. Beneath this bin is a pug mill or paddle mixer. The binder is carefully measured in correct proportion to the coal by means of a needle valve, is also introduced by this point. The matter of proportioning is very important. Too little binder results in a weak briquet that will disintegrate on subsequent handling, and too much binder in a soggy briquet produced at an excessive cost. The stirring action of the paddle mixer gives a preliminary mixing to the materials preparatory to fluxing, which is the next step in the operation.

The fluxer is a vertical cylindrical steel tank 40 in. diameter and 6 ft. deep, mounted on a cast-iron base. A shaft within this container carries a series of radial arms and rotates at a uniform speed. Stationary arms attached to the inner surface of the tank project toward the center. The partly mixed material is dropped into the fluxer from the paddle mixer. Here the ingredients are further mixed, or, as it is termed, fluxed, in the presence of steam admitted through openings in the bottom of the tank. This serves to moisten the mixture, or flux, as it is now called, and gives it a peculiar plasticity that facilitates the final mixing, or mastication. The flux is delivered directly into the masticator in a continuous stream, an adjustable gate regulating the flow at a rate synchronized with the delivery of the material into the fluxer.

The next and most important step in the operation of briquet manufacture is the mastication of the flux. The masticator is a ponderous Chilean mill, or *arrastre*. It consists of a heavy cast-iron bed securely bolted to a massive concrete foundation, two A-shaped standards mounted on the bed carrying the steel framework that supports the drive gearing and two huge cast-iron rolls, each weighing several tons, arranged to chase around the bed at eighteen turns per minute. The flux is fed in at the outer edge of

the bed and is gradually moved over by a series of adjustable plows to the center, where it is discharged.

Meanwhile the heavy rolls repeatedly passing over the fluxed material grind and masticate it to such an extent that the coal and binder are intimately mixed. In fact, the binder is literally ground into the coal, and the material has been changed into a practically homogeneous mass.

Under the masticator is a conveying device similar in design to the paddle mixer. This receives the masticated flux, reduces any caking, and delivers the material to a bucket elevator that carries it to the press, where the briquets are formed under a pressure of 3000 to 4000 lb. per sq. in.

Dropping from the press, the briquet fall directly into a bucket elevator which carries them to a rotating cylindrical screen. The peculiar shape and arrangement of the molds cause a small quantity of material to adhere to each briquet in the shape of a rough edge or fin. The tumbling action of the screen removes this material, and also eliminates occasional weak or imperfect briquets. This waste is returned directly to the masticator to be reworked.

Material to be briquetted passes through the press in a heated state, usually at 125 to 140 deg. fahr., and though the briquets at

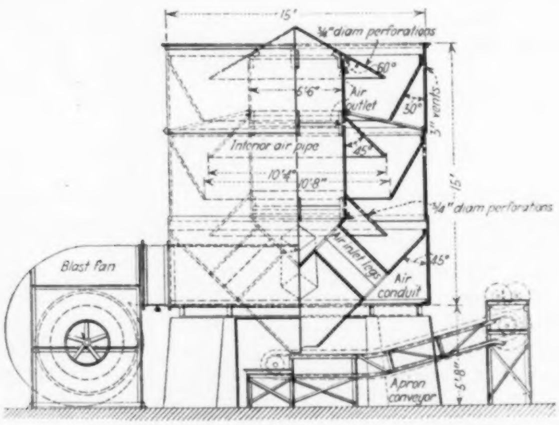


Fig. 1 Device for Cooling and Hardening Briquets

this temperature are strong enough to withstand the action of the elevator and screen, they are still so plastic that they would crush under the imposed weight of piling in a car or bin. It is necessary therefore that they be thoroughly cooled.

Instead of the usual water cooling of the briquets, air cooling is used. The air cooler, Fig. 1, is a vertical steel tank 15 ft. in diameter and 15 ft. deep, mounted on a concrete base. Extending through the center of the tank is an interior tower, or pipe of large diameter, which serves to conduct and distribute the cooling air.

Forming the top of the inner pipe and extending beyond its periphery, is a cone of projected area about half the area of the main tank. In order to give the briquets an inclined descent, and at the same time break up the mass into sections of small area, keeping the individual briquets in motion relatively to each other, a series of plates, or cones, are provided, so arranged that the briquets pass over first one and then the other as they move downward through the apparatus. These deflecting plates are placed alternately on the interior pipe and the exterior casing.

A funnel-shaped plate, attached to the exterior casing about 3 ft. from its lower edge and converging in the center with an opening for discharging the briquets, forms the bottom of the tank. The interior pipe is supported from this plate by four hollow legs. The annular space beneath the bottom plate is sealed and serves as a conduit for the air.

The required volume of air for cooling is supplied by a large fan connected to this annular conduit. From this chamber the air goes through the hollow legs into the interior pipe. A series of gaps, or openings, allow it to escape at points beneath the interior deflecting plates. These are perforated with many small holes, so that the air passes directly through the mass of briquets, absorbing their heat and finally escaping through vents in the outer casing to the atmosphere. The fan develops a pressure of about 1 oz. per sq. in. and maintains a constant circulation of air throughout the entire tank.

The briquets are received at the center of the cone top. In operation the tank is kept full, the discharge being controlled in accord with the input. The tank will hold fifteen tons, or an hour's output of the plant, and the briquets will thus be subjected to the cooling action of the air for this same period.

It is said that conditions in the coal trade in middle-eastern Canada are such as to favor the development of the anthracite briquet industry. (*Coal Age*, vol. 21, no. 10, Mar. 9, 1922, pp. 403–406, 2 figs., *d*)

HEATING AND VENTILATION

Mechanical Utilization of Energy Content in Steam at very Low Pressures as a Means of Improvement of Efficiency of Central-Heating Stations, Andre Nessi. The author discusses various types of heating such as hot-water and hot-air, and the methods of utilizing the mechanical energy content in the steam at very low pressures, which is a by-product of these installations. The article is essentially descriptive, and therefore not suitable for abstracting, notwithstanding its interest. The conclusion of the author is that in large heating units it is advisable to install machinery for utilizing the residue energy in the steam, providing, however, the operation of such machinery is continuous and automatic. The machinery can be so designed, as he shows, as not to entail any extra demand on the personnel operating the heating plant. (*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, vol. 133, no. 10, Dec., 1921, pp. 1322–1363, 31 figs., *dl*)

Reversed Heat Engine for Heating Purposes

The Reversed Heat Engine as a Means of Heating Buildings, P. B. Morley. In 1852 Lord Kelvin pointed out that in heating a building by the burning of oil one may employ an indirect process comprising a heat engine and "warming machine" driven by the engine, by means of which the heat delivered to the building might be much greater than heat of combustion of the coal consumed. In other words, the system, considered merely from the point of view of coal consumption, would work at an efficiency better than 100 per cent. The author states that he is not aware that this proposal has ever been put into practice and discusses the theoretical possibilities and the nature of the difficulties to be overcome in its application.

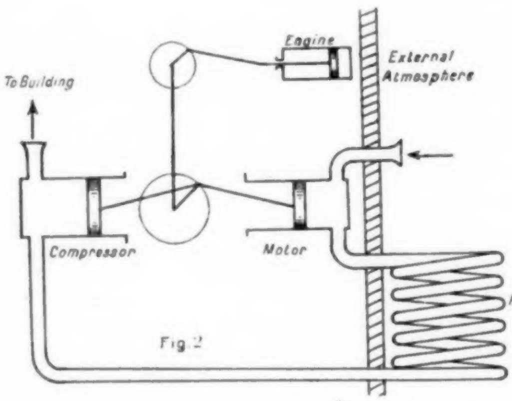
It being desired to pass into a building a supply of heated air, it is convenient that the air to be heated be itself the working substance in a reversed heat engine or warming machine. The machine would have two cylinders, which Lord Kelvin called "ingress" and "egress" cylinders. We shall refer to them as "motor" and "compressor," since the air does work in the former while work is spent on compressing in the latter. The cycle of operations would be as follows: Air from the external atmosphere would be admitted into the motor cylinder for part of the stroke, the inlet valve would then close and for the remainder of the stroke the air would expand, falling in pressure. The drop in temperature during the expansion would be reduced as much as possible by making the motor cylinder of highly conducting material with a large surface for heat transmission. On the return stroke the air would be discharged into a receiver, also designed to encourage heat transmission and having its external surface exposed to the external atmosphere or, better still, to a stream of water. The intention, in fact, is to obtain as nearly as possible isothermal expansion and to obtain in the receiver air at a pressure below that of the atmosphere and as little below the outside air temperature as possible. The receiver might well take the form of a coil of pipes as shown diagrammatically in Fig. 2. As the object is to obtain warm air finally, the warmer the air is in the receiver the better, provided the receiver temperature is not obtained by the expenditure of fuel or energy.

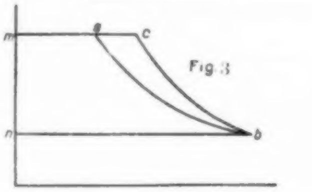
The low-pressure air would then be passed into the compressor cylinder and would be compressed therein till atmospheric pressure was again reached, the operation this time being adiabatic. The temperature at the end of compression would then be a maximum, and this heated air would finally be delivered into the building.

Fig. 2 shows diagrammatically the arrangement of the apparatus. The work spent on the air in the compressor would exceed the work done by it in the motor cylinder, the difference being supplied by an independent engine, water motor or electric motor.

The indicator diagrams for the process would be as shown in Fig. 3 or Fig. 4. In Fig. 3 it is assumed that the expansion is isothermal; the motor diagram is *mabn* and that of the compressor *nbcm*. Fig. 3 is for the more likely case in which the expansion *ad* is not isothermal, but in which the original temperature is regained in the receiver, the air therefore increasing in volume in the receiver from *nd* to *nb*. The point *b* corresponds to *b* in Fig. 3, and the compressor diagram *nbcm* is the same as before.

Lord Kelvin took as an example the heating of air from an external atmospheric temperature of 50 deg. fahr. to a final temperature of 80 deg. fahr. and calculated that by means of an ideal machine 1 lb. of air would be delivered per second with an expenditure of 0.283 hp. for driving purposes. The heat equivalent of this power is 0.2 B.t.u. per sec. The heat required to warm





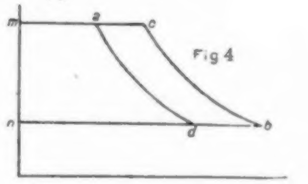


Fig. 2 Diagram of the Reversed Heat Engine

Fig. 3 Indicator Diagram of Reversed Heat Engine under Assumption that Expansion Is Isothermal

Fig. 4 Indicator Diagram of Reversed Heat Engine under Assumption that Expansion Is Not Isothermal

1 lb. of air from 50 deg. to 80 deg. fahr. is about 7 B.t.u., so that the heat given to the air would be thirty-five times the heat equivalent of the work spent.

As a means of supplying the driving power, Lord Kelvin contemplated a steam engine capable of converting into work one-tenth of the heat generated by the combustion of coal, so that the effect of the whole combination would be that the heat imparted to the air would be 3.5 times the calorific value of the fuel. A modern steam plant of the best type, has, of course, a much higher overall efficiency than one-tenth, amounting to 16 to 17 per cent of even higher in especially good power stations, and internal-combustion engines have a still higher efficiency. Thus, after allowing for losses of power and heat in the warming machine arising from friction and imperfect heat transference, it would appear probable that, by the method described, useful heating effect in the warming of air could actually be obtained with the expenditure of much less fuel than would be required to obtain the same effect by direct heating, even with the absolute elimination of the losses. Though at first sight this result is paradoxical, further consideration will show that it is in no way in conflict with the laws of thermodynamics nor, of course, therefore, with the law of the conservation of energy. (*The Engineer*, vol. 133, no. 3450, Feb. 10, 1922, pp. 145–146, 3 figs., *tm.* In this connection attention may be called to the paper presented by A. Altenkirch at the International Congress of Refrigeration in New York and Chicago, 1913 [Cp. *Eis- und Kaelte-Industrie*, vol. 6, no. 2, August, 1913, pp. 29–34], where an installation based on the same principles of operation was described and it was stated that several such units have been actually installed and put in operation on the continent of Europe.)

HYDRAULIC ENGINEERING (See Machine Design and Parts)

INTERNAL-COMBUSTION ENGINES

Flow of Gas into a Cylinder, A. Johnson. The article here abstracted deals with flow of air into a cylinder of an internal-combustion engine during operation. Under the circumstances adiabatic flow is out of the question and the air flowing into a hot cylinder is likely rather to gain than lose temperature. As a useful compromise it may be assumed that the temperature of the gas does not alter, so that PV is constant.

From a mathematical consideration of the subject the author arrives at the conclusion that, reckoned by weight, the rate at which air enters a cylinder (assuming no change of temperature) is greatest when the pressure inside the cylinder is little more than half the atmospheric pressure, or, to be accurate, that it would be so if the pressure within the cylinder were the same at all points, a condition inconsistent with the motion of the entering air but one which the author is compelled to assume for the purpose of approximate calculation.

From the point of view of the internal-combustion engineer dealing with an engine making many strokes in a second, the question of greatest interest is in what time he may expect his cylinder to fill, or what will be the density of the gas which it contains at the end of a given time.

This is again treated mathematically and the author arrives at the expression:

$$t = \frac{2}{R}\sqrt{\log p_0 - \log p_1}$$

where t is the time of filling the vessel completely; p_1 is the original pressure; p_0 final pressure, or the pressure in the cylinder when completely filled; and R in this case is a constant depending, however, on p_0. The author shows that under certain limiting conditions, expansion from $p = 15$ to $p = 3$ is about the range which permits the gas to flow in a stream of constant area. The remainder of the article, while of considerable interest, is not suitable for abstracting. (*The Automobile Engineer*, vol. 12, no. 160, Feb., 1922, pp. 41–43, 7 figs., *t*)

MACHINE DESIGN AND PARTS

Hydraulic-Power Transmission Gears, H. M. Sabine. In England, variable-speed hydraulic pumps and transmission gears have been found to be suitable for heavy-gun training, steering gears, winches, heavy-machine-tool and textile-machinery drives, rotary furnaces and tube mills, etc. The Williams and Janney gear has been chiefly applied as a transmission gear. The Carey and Hele-Shaw types have so far been chiefly employed as variable-delivery pumps, the latter system having, however, been applied also for transmission gearing. A hydraulic-transmission gear will also act as a clutch or brake.

What is wanted, and what certain of these transmission gears are being developed for, is a variable-speed pump, with a high speed of from 1000 to 1500 r.p.m., or even greater, and capable at this speed of delivering oil up to 1000 to 1500 lb. per sq. in., and about 4000 lb. per sq. in. pressure or more at about a quarter full speed. Overload pressures of 2500 lb. per sq. in. have been maintained already at slow speeds, and are being announced in the advertisements of the Carey and Hele-Shaw pumps and transmission gears. A Carey pump has actually worked at over 4000 lb. per sq. in. oil pressure for two hours on test, and as regards speed, 1000 r.p.m. is by no means too high a speed for certain medium-size pumps of the Carey type.

A great gain in efficiency will naturally ensue with the transmission gear or pump designed to run with air-filled case, owing to the elimination of the stirring losses which increase rapidly as the speed increases and which constitute the chief initial loss in

these machines. The temperature would be lessened, and therefore the oil would not get so thin, consequently the decreased leakage past the pistons and valve faces would result in greater efficiency. Further, the weight of the gear in working order would be less—a great consideration in automobile work—also the speed could be considerably increased.

An outline of some of the possibilities of variable-speed pumps and transmission gears, is followed by mention of some of their limitations. Transmission applications are classified under the following standard cases: (1) constant horsepower, with variable torque and speed; (2) constant torque, with variable horsepower and speed; (3) constant speed, with variable horsepower and torque. When dealing with inquiries from engineering and other manufacturing concerns, the author was frequently surprised at the apparent lack of knowledge regarding horsepower and power transmission. For instance, a firm would ask a quotation for a gear to transmit 10 hp. and to run between 500 and 20 r.p.m. If constant horsepower was required, the torque at 20 r.p.m. would necessitate using an extremely large pump, or alternately, an additional spur or worm reduction gear between the pump and the driven machine. Upon further inquiry, it would often happen that the full horsepower was not required at the slower speed. Again, a firm would ask for a gear to transmit, say, 50 hp. with a 5 to 1 speed range, and omit to give the maximum or minimum speeds, which, of course, would make all the difference in the size of the gear suitable. Many manufacturers seem quite unable to give the maximum and minimum torques together with the corresponding revolutions per minute for the machines they make. Sometimes a full questionnaire would have to be sent to a firm to get it to state particulars correctly.

The author gives a list of particulars required for designing a transmission set, and points out that usually the most important point is the torque range during which constant horsepower is being transmitted.

It is the maximum oil pressure which determines the torque or speed range, and the length of time the machine would be required to work at a maximum torque will determine the size to be employed. (*The Practical Engineer*, vol. 65, no. 1828, Mar. 9, 1922, pp. 151–154, 3 figs., to be continued, *dp*)

MACHINE TOOLS

Worm-Gear Generator

British Worm-Gear Generator. The generator described in the original article is suitable either for the accurate production of single wheels with a fly cutter or for the manufacture of gears on intensive lines by the use of hobs. The machine is of the tangent-feed type, with a special mechanism to impart an added movement to the wheel blank corresponding at the pitch line exactly with the tangential traverse of the cutter. This movement is obtained without the use of change gears, eliminating complicated calculations and difficulties in setting up.

Fig. 5 is a transverse section through the generating mechanism to illustrate the principles of action. The worm A which drives the work spindle B is supported between bearings on a slide parallel to the slide for the cutter arbor. The driving worm is of exceptional length, and it is possible to rotate the work spindle by an axial movement of the worm, in addition to the regular motion which is obtained by the rotation of the worm shaft. For this purpose the substantial lever segment C pivoted on a large vertical pin D is provided with radial slots having slide blocks which operate the respective slides.

To obtain the correct relative motion between the cutter slide and the wheel blank, it is then only necessary to make the distance from the center of the pivot for the lever segment to the lower sliding block equal to the pitch-line radius of the driving worm wheel for the work spindle, while the distance from the center of the pivot to the center of the upper sliding block is made equal to the pitch-line radius of the worm wheel to be cut. Further, by the provision of special measuring faces, this setting may be made accurately without difficulty, so that the arrangement for obtaining the correct relative movements between the cutter and the work may be said to represent a distinct advance on the previous methods employed.

The measuring faces for this purpose may be seen at F, in Fig. 5, and the method of adjusting simultaneously to the correct position will be clear when it is observed that the cutter slide is mounted on a second transverse slide, which is actuated by means of two guide screws through the medium of a hand-operated shaft and spiral gears. It should also be mentioned that the faces of the measuring blocks are a known distance apart when the pitch line radius of the hob is zero, so that the required distance may always be obtained by subtracting half the pitch diameter of the worm from the fixed distance given by the makers. This enables measuring rods or plug gages to be employed for setting purposes, a method which is calculated to give the greatest degree of accuracy with an unskilled or semi-skilled operator.

A simple form of gage is also fitted for setting fly cutters, the gage being shown above the cutter in Fig. 5. Briefly, it consists

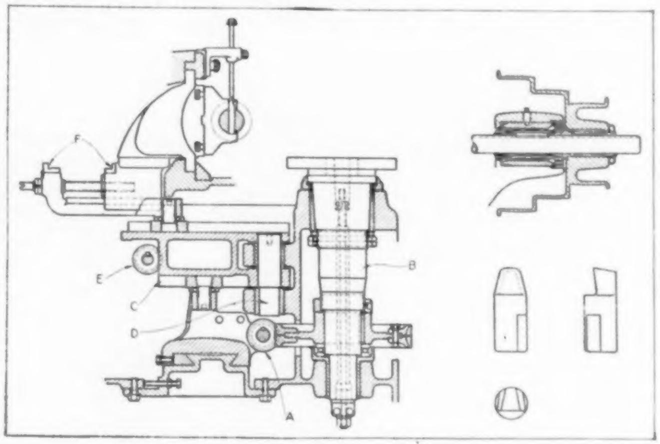


Fig. 5 Worm-Gear Generator

of a small bracket located against a suitable face on the slide, and carrying a sliding rod having a collar at the upper end. The length of the rod is then made equal to the distance between the upper face of the bracket and the center, so that the distance from the lower end of gaging point of the rod to the center of the cutter spindle is exactly equal to the distance between the face of the gage block and the collar on the rod. By this means, the correct setting of a fly cutter may be obtained readily by employing a plug gage equal in width to half the outside diameter of the hob represented by the fly cutter. The gage rod may then be clamped in position, so that, although the bracket is removed after setting the cutter, any future settings may be made with the minimum of trouble.

The method of mounting the fly cutter in the arbor also possesses features of interest, and as in the case of other setting operations the object has been to minimize the time required for setting. From the lower right-hand figures in Fig. 5, it may be seen that the cutter is formed out of cylindrical stock, the end being shaped to the normal section of the worm thread, while the shank is cut away at one side, as shown, to simplify the location of the cutter at the correct spiral angle of the arbor. Clamping may then be effected by means of an axial set screw passing through the cutter arbor, and bearing against the flat on the tool. This arrangement has the advantage that the stress on the arbor is central, so that there is no tendency to distortion, as is often the case when cutters or wedges are used for clamping purposes.

Regarding the drive for the tangential feed motion, the worm shaft is extended to a large capstan wheel, and this wheel in turn is frictionally driven from a worm wheel to which power is transmitted through the medium of a feed reverse and change box at the rear of the machine. This feed box provides for twenty feed changes, covering a range of more than 140 to 1. The trip mechanism is of the instantaneous type, the clutch being released in approximately one-eight of a revolution. Notwithstanding the fact that the worm slide which operates the trip mechanism may have a very slow movement. (*Engineering Production*, vol. 4, no. 73, Feb. 23, 1922, pp. 187–188, 4 figs., *d*)

A New British Chucking Machine

An Improved Automatic Chucking Machine. Description of a machine developed in England for work on intricate pieces. The machine, called the "Victor," is intended particularly to be used on locomotive-piston work. It is said also that it will handle all kinds of taper work and bevel-gear work without extra fixtures. In railway shops it may also be used for work on split rings, valve heads, valve followers, bull rings, piston-rod glands, valve-spindle glands, piston-valve covers, main-cylinder covers, eccentric liners, etc.

All automatic changes in this machine are actuated through positive-action friction clutches, and are obtained by the very simple mean of setting dogs on drums immediately under the headstock. The clutches adjust themselves automatically to the load, and require no attention whatever. The main spindle is of large diameter, fitted with ball thrust washers and supported by two substantial phosphor-bronze adjustable bearings. It is arranged to stop automatically before the withdrawal of any cutting tool, and to take up the drive again when the next tool is brought forward for cutting. The turret has four operative faces, and is fitted to the saddle on two coned surfaces. The locating ring is of larger diameter than the turret, the indexing plunger working between adjustable wedges. After locating, the turret is locked to the saddle by a central bolt and locking plate, the turning, locating and locking, all being performed automatically at a high constant speed, the turret and saddle being then securely locked. It is claimed that rigidity, together with absolute alignment, is secured by this arrangement.

Two independent cross-slides are provided, the top slides swivelling to any angle. Both cross-slides have longitudinal and cross automatic movement actuated by the saddle traverse, angular cuts being obtained in like manner. Adjustable micrometer stops are provided for all cross-slide movements, insuring great accuracy. Each cross-slide can be set to have a combined cross, or angular and longitudinal movement, thus enabling a tool to be fed up to its work against a transverse stop and then traversed longitudinally, or vice versa. Each cross-slide can be operated with any face of turret. Provision is made for profiling in conjunction with both cross and longitudinal traverse.

The feed is transmitted from the main spindle through a safety clutch and five-speed gear box to the cam drum shaft, the feed changes being operated by adjustable dogs attached to the change-feed drum. The quick motion of the saddle is taken from the first-motion shaft, which is fitted with a safety clutch, and runs at a constant speed independent of the spindle or feed changes. It is actuated by means of a trip lever, instantaneous in action, the movements from slow to fast or vice versa being operated within $^3/_8$ in. of saddle movement. A conveniently actuated hand motion to saddle and cross-slides is provided, and, by means of a hand lever, all cam gearings can be thrown out of action, leaving only the main spindle operative for chucking purposes. (*The Railway Gazette*, vol. 36, no. 9, Mar. 3, 1922, pp. 351–352, 2 figs., *d*)

PHYSICS

Velocity of Sound in Air and Hydrogen at 0 Deg. Cent. and 1 Atmos. Pressure, E. Grueneisen and E. Merkel. The subject is of considerable interest because velocity of sound appears in equations dealing with the design of steam and internal-combustion engines; in particular, in connection with the subject of critical velocity of flow of gases through nozzles. The authors carried out the measurements in connection with their investigation of velocity of sound in partially dissociated gases, and the present paper covers measurements on dry air free of carbon dioxide, and on pure hydrogen. The method of measurement is of the kind suggested by Thiesen; viz., with a closed resinator. The paper deals chiefly with the methods of measurements and the various precautions for eliminating sources of error. The final value the writers derive is that the velocity of sound in dry air, free of carbon dioxide at 0 deg. cent. and atmospheric pressure, is 331.57 m. per sec., and in pure hydrogen 1260.6 m. per sec. (*Annalen der Physik*, vol. 66, series 4, no. 5, 1921, no. 21, pp. 344–364, 4 figs., *eA*)

POWER PLANTS (See also Steam Engineering)

The Ruths Steam Accumulator

The Ruths Steam Accumulator, G. Schulz. All steam accumulators, of which there are a good many, are designed for the purpose of saving fuel by enabling the boiler to operate at its most economical load without (within certain limits) being affected by the demand at the prime-mover end. Thus, in an electrical plant the boiler would operate at its most economical load no matter whether the electrical load were near its peak or at a minimum. It is said that the Ruths accumulator successfully accomplishes this purpose.

The essential novelty in the Ruths accumulator is not the accumulator vessel itself but its connections: viz., the fact that it is inserted between the boiler room and the steam piping. The accumulator itself, Fig. 6, is merely a large boiler of simple design filled with water to about 90 per cent of its capacity. The steam enters through valves X_1, Y_1 into the distributing manifold Z and passes therefrom through nozzles P. These nozzles act like jet pumps, and their purpose is to produce a rapid and intimate mixture between the steam and the water. The exit of the steam takes place through nozzle F, shaped like a DeLaval nozzle. With this type of nozzle the steam flow is, up to a certain degree, independent of the back pressure. The nozzle permits the passage of only a limited amount of steam, and acts as a kind of safety valve in case of a rupture of a pipe. On one of the front walls of the accumulator is to be found a water level indicator W properly calibrated and intended to be used for maintaining the water level in the accumulator at a predetermined height. In actual practice it was found that it is only seldom necessary to add fresh water. The vessel is well insulated so that, practically, the heat losses therefrom need not be considered.

As stated above there is nothing strikingly new in the construc-

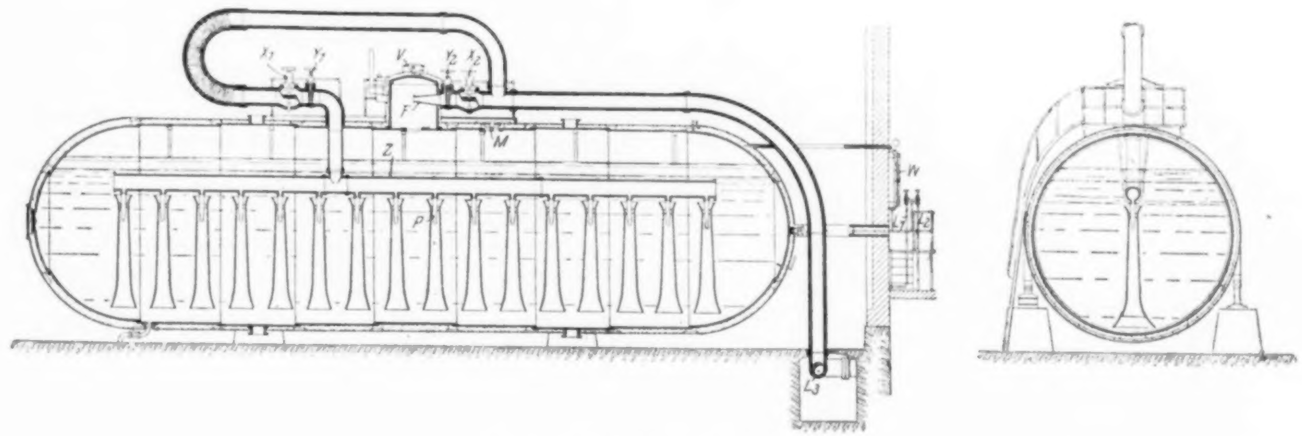


Fig. 6 Ruths Steam Accumulator

tion. What is new is the fact that the accumulator with its great content of water is so connected in the system that pressure variations of several atmospheres may be permitted in the steam piping. Furthermore, the operating range is set chiefly into the region of low pressures, which reduces the initial cost of the installation and increases the ability of the accumulator to handle large amounts of steam.

In the original article is given a curve showing the relation between the steam absorption of an accumulator and the various steam pressures. From this curve it appears that the steam given up by a cubic meter of water at a pressure drop of 1 kg. per sq. cm. varies for different pressures quite materially. For example, at 20 atmos. 5 kg. of steam are given up, but at 3 atmos. more than 20 kg. of steam are given up, which would indicate that the steam-absorption capacity of an accumulator rapidly increases with the lowering of the level pressures.

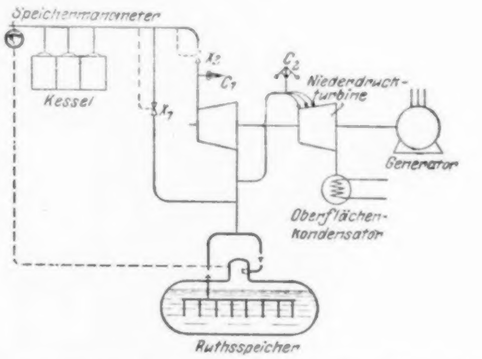


Fig. 7 Diagram of Connections for a Steam-Driven Central Station with a Ruths Accumulator

In the original article, reference is made to tests by Professor Josse showing the great advantage obtained with uniform demand on the boiler as compared to a variable demand, which is of interest as the aim of the Ruths accumulator is to create such a uniform demand. Furthermore, the original article shows several schemes of using the Ruths accumulator, for example, in connection with a central station or an electric plant operating in a blast-furnace plant.

One of these connections for use in a central station taking care of such a load as a city load is shown in Fig. 7. The figure is to a certain extent self-explanatory, though the following may be mentioned in connection with the operation of the plant. The stoking of the boiler is carried on at a uniform rate, and but little attention is paid to the manometer on the boilers.

If the boiler pressure exceeds a certain amount, the valve X_2 opens up and the steam flows to the high-pressure turbine, being further divided according to the position of the governor C_2 between the low-pressure turbine and the steam accumulator. If the boiler pressure goes down, the valve X_2 begins to close and less steam goes to the high-pressure turbine. As the speed of rotation of the turbine falls off the governor C_2 opens the main valve and the accumulator begins to give up steam, the low-pressure turbine taking up the load which has been taken off the high-pressure turbine. With such an arrangement, the pressure head on the steam is completely utilized with the exception of the liquid head on the accumulator which amount to about 0.1 atmos. and for practical purposes may be neglected. The bypass with valve X_1 permits the steam to go directly to the accumulator. This valve opens only, however, when X_2 is wide open, i.e., at very low loads, and the purpose of it is to send the steam to the accumulator where it may do some good instead of letting it into the atmosphere through the safety valve.

The only instrument in the boiler house shown on the figure is the accumulator manometer. If the accumulator pressure becomes either too high or too low, the fireman has to manipulate the dampers. With properly dimensioned accumulators, however, this would happen only very seldom under regular conditions of operation. (Paper before the Machinery Board of the Verein deutscher Eisenhuettenleute, abstracted through *Stahl und Eisen*, vol. 42, no. 5, Feb. 2, 1922, pp. 165–171, 9 figs., *dA*)

RAILROAD ENGINEERING (See also Machine Tools)

Hungarian Locomotives and Their Auxiliaries

Locomotives for Hungarian State Railways, Desider Ledacs Kiss. To meet local conditions the Hungarian State Railways adopted for their new locomotives a type with two simple cylinders in place of the four-cylinder compound arrangement, but provided the locomotives with several specialties.

Because of the scarcity of copper, the locomotives constructed soon after the armistice were equipped with boilers of the Brotan type. These boilers are provided with a water-tube firebox, though the boiler shell immediately in advance of the firebox tube plate is cylindrical instead of conical, which is a departure from the standard Brotan type. The firebox is placed above the last coupled wheels and is much wider than the frame. In order to protect the last pair of driving wheels from the radiant heat of the burning coal immediately above the wheels, protector plates were applied. Further, to avoid dead grate surfaces, it was found necessary to have built upon them a sort of multi-stage grate. The forward part of the firebox has a drop grate. There is also in the firebox a semi-automatic smoke consumer, operating on the principle of introducing air through four passages in the brick arch above the grate.

To provide for the circulation of water, the firebox ring of the Brotan-type boiler is connected with the last shell of the boiler barrel. The steam dome containing the balanced slide valve for throttling the steam is located on the first course of the boiler. Over the second course is located a feedwater purifier with eight cells, which has been applied to 3000 locomotives on the Hungarian System.

The locomotive equipment includes also a centrifugal water-intercepting device, or steam desaturator, placed in the dome; also several other specialties, such as a speed recorder, acetylene cab lamps, a feedwater-heating system, etc. The flanges of the forward driving wheels are lubricated by the condensation water from a feedwater pump included in the feedwater-heating system. This system (Knorr) consists of two preheating cylinders, one located on the right-hand side, and the other on the left-hand side of the locomotive. These are connected and serve for preheating the feedwater by the exhaust steam diverted from the exhaust passages of the locomotive. Experience on the Hungarian State Railways has proved that if one-fifth of the exhaust steam from the locomotive cylinders is diverted to the feedwater heater, it will have no appreciable effect on the draft of the locomotive. The exhaust steam is conducted separately into the preheating cylinders located on both sides of the locomotive. In addition to this, the right-hand heater received exhaust steam from the Westinghouse air compressor, and the left-hand heater receives the exhaust steam from the Knorr feedwater pump. The partially-condensed steam from these preheaters is drained underneath the boiler.

The feeding of the boiler is accomplished by the single Knorr feedwater pump and the two Friedman injectors. The left-hand injector and feed pump conveys the feed water through the preheating device, i.e., the water runs through the injector or feed pump first into the left-hand and then into the right-hand preheating cylinder and from there passes through the water purifier into the boiler. This method of operation is used because it has proved the most economical. When the right-hand injector is used, the feedwater runs only through the water purifier and then direct to the boiler.

With the Knorr duplex feed pump, the water cylinder has a steam heating jacket, wherein also the exhaust steam of the pump is conducted. On the up stroke of the piston the water enters through the right-side suction valve and at the same time pushes the water from the upper cylinder chamber through the left-side delivery valve into the delivery pipe. Vice versa, the left-side suction valve and the right-side delivery valve are actuated on the down stroke. The maximum capacity of the pump is 80 gal. per min. The preheating cylinders are filled entirely with straight tubes through which the feedwater makes two passes. The exhaust-steam chamber is also partitioned, so that the steam flows from one end of the heater to the other and back to a point where it is drained, but in an opposite direction to the course of

the feedwater. In order to eliminate the water of condensation, together with the mud which is found to eventually settle in the base of the heater, suitable valves and washout fixtures are provided. (*Railway Review*, vol. 70, no. 9, March 4, 1922, pp. 277–291, 6 figs., *d*)

THE PASSING OF THE CROSS-COMPOUND ENGINE. The Canadian Pacific Railway, at its Angus Shops, has converted a number of 10-wheel cross-compound locomotives into simple locomotives of the same type, equipped with superheaters and piston valves. These locomotives will work in sparsely settled sections where the number of passenger and local freight trains must be fairly large but heavy power is not required, and where at the same time severe operating conditions are encountered during the winter months. Under these conditions the modernization of certain classes of old locomotives involves a much lower capital charge than the purchase or construction of new locomotives, and furnishes the railroad with a type of motive power quite as suitable as new locomotives for this service.

Some of the New England railroads have done similar converting, and have even extended it to include small 8-wheel passenger locomotives which have been fitted with new boilers and superheaters for light local passenger service.

The original article gives the details of the alterations carried out in Canada. (*Railway Review*, vol. 70, no. 8, Feb. 25, 1922, p. 265, 2 figs., *d*)

ADHESION AND RACK LOCOMOTIVE FOR THE DUTCH STATE RAILWAYS IN SUMATRA. The adhesion and rack locomotive is designed to operate on very heavy grades on the west coast of Sumatra, a portion of the line being provided with a rackbar of the Riggenbach type. The rack portion has grades of from 5.1 per cent to 6.8 per cent and a total length of 22.5 miles. The radius of the sharpest curves on the rack portion of the line is in the neighborhood of about 500 ft.

Up to the present time, six types of locomotives have been built for service in this portion of the line. The former locomotives were of the 4-wheel coupled type. The design described here is of the 0–10–0 type and was built in Switzerland. The usual system of operation is for a train of, say, 360 tons to be handled by two locomotives, one in the middle of the train and the second at the rear.

The boilers are provided with Schmidt superheaters. The barrel of the boiler consists of two courses, and contains 64 tubes, 12 ft. $9^1/_2$ in. long and 18 flues of the same length for the superheater elements. The firebox is of copper. The working pressure is 205 lb. per sq. in.

The driving wheels are $39\ ^3/_8$ in. diam., the leading and trailing drivers having a side play of about $^7/_8$ in. The rack wheel is driven from a separate set of cylinders, located above the main cylinders through a jackshaft across the top of the locomotive frame. On this jackshaft is mounted a spur gear which meshes with the gear on the cog-wheel axle. The pitch diameter of the driving rack wheel is $38^3/_8$ in. The gearing between the crank axle and the main cog-wheel axle has a ratio of 1 to 2.033. The gear teeth are of the helical type with the pitch angle of 23 deg.

The locomotive is of the 4-cyl. compound Winterthur type, with all four cylinders outside the frames, two on each side. The lower cylinders are high-pressure and drive the five coupled adhesion axles. The upper or low-pressure cylinders drive the main cogwheel, and are not in operation while the locomotive is running on the adhesion track. While the locomotive is on the adhesion track the exhaust steam from the high-pressure cylinders passes directly to the exhaust pipe. When it is desired to place into operation the low-pressure cylinders which run the rack wheel, the engineer by means of a steam-operated valve, changes the flow of the exhaust steam from the high-pressure cylinders into the steam chest of the rack or low-pressure cylinders. From these cylinders it passes to the exhaust. In this way the locomotive is propelled both by the five-coupled axles and the rack when ascending the rack grades. In order to insure starting with the load on the rack portion of the line, live steam can be admitted directly to the low-pressure or rack cylinders by means of a special valve, so that the locomotive works as a twin engine. The four cylinders are of the same diameter and have the same stroke. They are cast separately in order to facilitate removal and repairs.

Three of the fifteen locomotives are equipped with Caille-Potonie feedwater heaters and double-acting feedwater pump, illustrated in the article. (*Railway Age*, vol. 72, no. 4, Jan. 28, 1922, pp. 263–266, 8 figs., *d*)

SPECIAL PROCESSES (See also Fuels and Firing)

A SIMPLIFICATION IN MAKING SHEET-METAL PRESSINGS. The usual process of manufacturing such sheet-metal parts as automobile fenders involves the use of a male and female die, which means, of course, a considerable expense. A new process of making such articles has been worked out in Australia and is known as the Hydro-Press process.

In this process the female die is of cast iron and requires only to be tooled sufficiently to remove any roughness in the casting so as to give a smooth and even surface. The place of the male die is taken by another cast-iron die containing a "bag cavity." In place of an accurately fitting male die, however, there is placed in the cavity a reinforced rubber bag capable of being expanded by the injection of water under high pressure. The metal sheet to be pressed to shape is laid on the rubber bag. The metal female die which grips the edges of the sheet between itself and the edges of the bag cavity is lowered by the operation of the cams. Water pressure is then turned on by the operator and the resulting expansion of the bag forces the metal to the shape of the female die. The normal working pressures used in Australia vary from 300 to 750 lb. per sq. in. The pressing into shape of the metal sheet is a matter of moments and the release of water and the separation of the dies enables the completed work to be replaced by another sheet of metal. In addition to automobile body panels, aluminum kitchenware has been made by the same process. (*Automotive Industries*, vol. 46, no. 8, Feb. 23, 1922, p. 469, 1 fig., *d*)

STEAM ENGINEERING (See also Thermodynamics, Physics, and Power Plants)

CONTRIBUTION TOWARD A PRECISE METHOD OF COMPUTING STEAM-TURBINE-BLADE WHEELS OF VARIABLE THICKNESS, Alex. Fischer. A mathematical article not suitable for abstracting, but the following summary presents the main points. In the first place, the author considers the differential equation given by Stodola for determining the radial displacement of rotating disk wheels. This equation has been hitherto applied only to disks of even thickness and hyperboloidal disks. The equation was only partially solved for the so-called disks of equal strength. The author attempts to give a solution for disks having a section of the form $y = (\pm 1)^n y_0 \left\{ 1 - k\left(\frac{x}{r_0}\right)^m \right\}^n$. Under this classification of disks fall besides disks of even thickness and of hyperboloidal cross-section, also those with trapezoidal and conical section as well as disks of equal strength. For this particular class, the Stodola differential equation may be transformed into the Gauss equation of hypergeometric series. The theory of the Gauss equation is briefly discussed and its application to the present problem shown. The author shows that while in general the solution of the Gauss equation appears in the form of a series, and more particularly hypergeometric series, under certain limited conditions it gives finite expressions for the radial displacements and stresses. The data thus obtained are tested by applying them on disk shapes where the solutions are known and finite. The results are also applied to the complete solution for the case of a disk of equal strength. It is shown in this connection that under the limited conditions prescribed by practical requirements this type of disk fully lives up to its name.

In the second part of the paper is discussed the connection between the differential equation of Stodola for radial displacement, and the differential equation of the stress function proposed by A. Foeppl, and also the differential equation of Stodola for the bending of a horizontal disk of uneven thickness under the influence of its own weight. (*Zeitschrift des Oesterr. Ingenieur- u. Architeken-Vereines*, vol. 74, no. 9–10, March 3, 1922, pp. 46–49, 2 figs., to be continued, *mpA*)

THERMODYNAMICS (See also Heating and Ventilation)

The Specific Heats of Air, Steam and Carbon Dioxide, W. D. Womersley. The author used apparatus of the recording-calorimeter type essentially similar to that designed by the late Prof. Bertram Hopkinson, but improved. Instead of using coal gas he mixed the less complex gases, hydrogen and carbon monoxide, with either air or oxygen. The actual range of the experiments is from 1000 to 2000 deg. cent., the parts in the curves in the original article referring to the lower temperatures being filled from the researches of Swann, and Holborn and Henning. The method of calculations is very completely described.

The results obtained are given in the form of curves. The figures for air and steam are about $7^1/_2$ per cent higher than those of Holborn and Henning at 800 deg. cent., and the author assumes that their values for carbon dioxide are a similar amount too low.

In connection with this investigation the effect of the state of the walls of the containing vessel on the rate of heat flow in a gaseous explosion has also been considered. The author carried out a series of experiments with the Hopkinson calorimeter to find the total heat passed to the walls after an explosion—first, with the walls polished, and then blackened. Coal gas was used in the combustible mixture and five experiments under different conditions were made. The same mixture strength was used throughout, viz., 12.35 per cent of coal gas by volume. The cooling curve and the total heat lost to the walls are shown by a curve in the original article, the maximum temperatures of which are 2123 deg. and 2089 deg. cent. abs., respectively, giving a difference of 34 deg. cent. At the end of one second the gases have cooled to 918 deg. and 859 deg. cent. abs., the difference then being 59 deg. cent. The heat lost to the walls in the two cases when cooling has proceeded to the same temperature is sensibly the same. At one second the heat passed to the walls per square centimeter per gram-molecule is 2.675 and 2.556 calories, respectively.

Another curve in the original article shows the rate of heat flow to the walls at various times during the cooling. From this it is seen that during the first half second the rate of flow is much greater with the walls black than when they are polished. After this time the rates seem to be practically the same in the two cases. The general rate of flow appears to be 16 per cent higher throughout with the blackened walls. From the temperature curves are derived the relations between the rate of heat flow and the difference of mean gas temperature and walls. (*Proceedings of the Royal Society*, Series A, vol. 100, no. A 706, Feb. 1, 1922, pp. 483–498, 10 figs., *et*)

Effect of Variable Specific Heat on Discharge of Gases Through Orifices and Nozzles, Wm. J. Walker. The paper questions the desirability of accounting for abnormal orifice or nozzle discharges by consideration of changes in the value of γ, the index in the equation pv^γ = constant, for adiabatic changes of state. This appears, generally, to have been the custom hitherto, but since the actual adiabatic equation under linear-variable specific-heat conditions is $pv^m e^{kT}$ = constant, the analysis in this paper has been carried out on the latter basis for the purpose of determining, as nearly as possible, what effect such specific-heat variation has on discharges. An exact solution does not appear to be derivable, but the method of analysis adopted here may be carried to any degree of accuracy required. The method of analysis is somewhat similar to that adopted in a previous paper (The Effect of Variable Specific Heat on Thermodynamic Cycle Efficiencies, *Philosophical Magazine*, September, 1917), dealing with another effect of variable specific heat. The result obtained in the present paper brings out prominently the fact that the error in computing discharges (by the usual constant-specific-heat theory) increases as the density of the medium in the reservoir is diminished. This fact appears to have been neglected in previous considerations of the subject. It is pointed out, also, that by means of the discharge formulas obtained the method of orifice discharge may be used as a reliable and convenient one for the determination of specific-heat variations with temperature. (*The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, vol. 43, no. 255, March, 1922, pp. 589–593, *tm*)

Influence of Colors on Heat Absorption of Paints and Bricks, Maj. C. R. Satterthwaite. Data of experiments on influence of color and heat absorption of various materials in hot sunlight were carried out in the Soudan during the period of 1915–18 by G. W. Grabham. The experiments were on the properties of various materials and fabrics used for clothing, but tests were also carried out on painted surfaces and bricks.

For the purpose of the experiments, cylindrical tin flasks $12^1/_2$ cm. and $7^1/_2$ cm. in diameter were adopted. They were provided with necks and corks through which thermometers were inserted so that the bulbs were placed freely at about the center of the flasks.

In the principal experiments the flasks were laid out on a white sheet resting on a doubled woolen blanket, to eliminate as far as possible disturbing factors due to heat absorption by their surroundings. They were set at intervals of about 30 cm., and arranged in order of their apparent tints so that the lighter-colored flasks were next each other and distant from the darker ones. These precautions were taken to reduce effects due to radiation from one flask to another, such as might have interfered had a black flask been near a light-colored one. Standards of reference were provided by other flasks, the white being coated with a lime wash which gave a dead-white surface, while the other was coated with a mixture of lampblack and varnish which dried with a dull-black surface.

From the mean of several observations it was found that, with the "White Standard" (lime wash) at 115.9 deg. fahr., the following colors showed the excess temperatures given below.

	Deg. Fahr.
Cream paint	11.5
Khaki paint	22.5
Cement wash	26.8
Black paint	35.2

In experiments on bricks, a detailed procedure of which is given in the original article, it was found that burnt brick was much hotter than sun-dried brick, which may have been due both to direct heat absorption and also to texture. (*Journal of Hygiene*, vol. 19, no. 3, Jan., 1921, abstracted through *The Royal Engineers' Journal*, vol. 35, no. 3, March, 1922, pp. 129–132, *e*)

VARIA

Weighing by Substitution. Substitution weighing is of importance when it is desired to obtain very accurately the weight of some particular object and when calibrating or adjusting weights in the process of standardizing them.

The scheme of weighing by substitution is as follows: For standardizing weights the standard is first placed on the scale pan or platform designed to receive it and counterpoised by any convenient material. When the balance of the beam is obtained the standard is removed, the weight to be compared is substituted and the correction is determined from the small weights that have to be added or subtracted to establish the same balance as before.

Where the weight of an object is desired and its weight is not already known approximately, it is first placed upon the platform and balanced by a suitable counterpoise. It is then removed and standard weights substituted until the same balance is established as before. The weight of the object is then equal to the weights substituted for it. The method of substitution weighing is rendered precise by observing certain details explained in the original paper.

As explained by the Bureau of Standards, the process may be used for obtaining weighings of considerable refinement with ordinary forms of compound lever scales. (*Technologic Paper of the Bureau of Standards*, no. 208, Feb. 21, 1922, pp. 177–192.)

CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society.

ENGINEERING RESEARCH

A Department Conducted by the Research Committee of the A.S.M.E.

Metallic Corrosion Under Investigation

THROUGHOUT the country during the past year a considerable amount of research on the general subject of corrosion has been carried on. This activity, in spite of the general relaxation in chemical and metallurgical research, is due probably to the extreme importance of many of the problems and to the large savings in capital and labor that would result in their solution. The laboratories of the Government, private concerns and the colleges are participating in this work.

It was for the purpose of coördinating this research activity that The National Research Council recently appointed a committee on this subject to function under its Division of Research Extension. Mr. W. M. Corse, Gen. Mgr., Monel Metals Products Corporation, Bayonne, N. J., is Chairman and Dr. Colin G. Fink of 101 Park Avenue, New York, is Secretary of the Committee.

This Committee is, first, to serve as a general clearing house for information on the subject and, second, to devote its attention essentially to a fundamental scientific study of corrosion in all its aspects. It desires to get quickly in touch with the work which is being done on corrosion whether through societies, associations, institutes, universities, private laboratories, or industrial laboratories. It is known that the following thirteen organizations are at present interested in the general problem through committee activity.

American Society for Testing Materials	American Water Works Association
Bureau of Standards	National Electric Light Association
American Institute of Electrical Engineers	National Gas Association of America
American Gas Association	Engineering Foundation
American Electric Railway Association	The American Electrochemical Society
American Railway Engineering Association	Bureau of Mines
	National Canners' Association

The corrosion problem is being attacked from two more or less different angles. In the one case every effort is being made to arrest the corrosion of the materials now in use, in the other new materials are substituted and tried out. A partial list of distinct problems of corrosion which demand investigation are listed below, each being centered around some specific material or article of manufacture.

Condenser Tubes	Alloys Resistant to High Temperature
Automobile Radiators	Corrosion of Zinc Cathodes
Underground Cables	Contact Metals or Alloys
Buried Iron Pipes, Posts, etc.	Catalyzer Metals or Alloys
Fence Wire	Cutlery Steels
Flues, Stacks, Stove Pipes	Acid Tank Linings
Steel Ships and Ship Fittings	Corrosion of Nickel-Plated Ware
Roofing Materials	Boiler Tubes
Mine Pumps and other Mine Equipment	Fire Boxes
Atmospheric Corrosion of Brass	Insoluble Anodes
Atmospheric Corrosion of Bronzes	

Cast Iron when Affected by the Presence of Small Amounts of Other Elements. Three general problems involved in this research are (1) Velocity of corrosion as affected by (*a*) temperature fluctuations, (*b*) alternate dry and moist surface, (*c*) presence of foreign materials, (*d*) presence of oxide or carbonate of one or the other constituent of the alloy, (*e*) crystal structure and intercrystalline cement; (2) properties of the surface film: (*a*) coefficient of expansion as compared with that of the underlying metal; (*b*) its chemical composition; (*c*) porosity; (*d*) flexibility or ductility; (*e*) coefficient of adhesion; (*f*) speed of renewal of "healing;" (*g*) relative hardness; (*h*) how effected during mechanical working; and (3) corrosion and bacteria.

A more complete micrographic investigation of the changes taking place in the film and the metal underneath, during the process of corrosion, is very desirable. Furthermore, progress will come more rapidly as soon as it is agreed what shall constitute a standard test when used to determine the relative corrodibility of two samples. At present it is almost impossible to compare the results of one observer with those of another, even when both of them have work on the same materials in their tests.

Within the last year, however, decided progress has been made in the study of cutlery steels, metals and alloys for mine equipment, cable sheath, insoluble anodes, alloys resistant to high temperatures, and the corrosive action of molten metals such as zinc, tin, etc. But the solution of the corrosion problem, as a whole, in spite of its long past history, is still in its "infancy" and it is only through coöperative effort and a free discussion of results (those usually suppressed as well as those suitable for advertising purposes) that consistent forward strides are possible.

Research Résumé of the Month

A—Research Results

The purpose of this section of Engineering Research is to give the origin of research information which has been completed, to give a resume of research results with formulas or curves where such may be readily given, and to report results of non-extensive researches which in the opinion of the investigators do not warrant a paper.

Apparatus and Instruments A2-22. Weighing by Substitution. This paper describes a plan for making substitution weighings which can be applied in using either equal-arm balances or compound lever scales. It is based upon the method developed by the Bureau of Standards in the test and standardization of the 10,000-lb. weights which form a part of its railroad track-scale testing equipments and in which a maximum accuracy is desired. The interest of the practical scale man coming in contact with the work of the Bureau has been aroused in its methods, and the present publication is prepared mainly in response to a general demand for an outline of a systematic method for carrying out substitution weighing. As the result of suggestions of these men engaged in the actual maintenance and testing scales, the procedure for taking data and conducting the routine of the test has been made to conform closely with that used by the Bureau of Standards in the precision test of railroad-track and grain-hopper scales; and the form for recording the data and making computations which is presented has been arranged to be as near to that used in the scale-testing work as is practical.

The general matters covered by the paper comprise, first, a general description of the theory of weighing by substitution; the preparation of the scale for weighing so that the swings of the beam can be read on the graduated scale; the method for obtaining the positions of the equilibrium of the beam from the readings taken on it while moving; the method of removing and substituting weights; and a description of the details to be observed in preparing the scale and making observations, and the practice to be followed in making the computations.

The method is of especial value in the calibration of a large number of weights of the same denomination. The method is equally applicable, however, for determining accurately the unknown weight of any object. Technologic Paper of the Bureau of Standards, No. 208, by C. A. Briggs and E. D. Gordon. The complete paper may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

Instruments and Apparatus A2-22. Weighing by Substitution. See *Apparatus and Instruments A2-22.*

Thermal Conductivity A1-22. Thermal Conductivity of Some Wearing Materials. Thermal Conductivity of Woolen, Cotton, Linen and Silk Materials.—Measurements of the conductivity of samples of knitted and woven materials have been made by the disk method of Lees, corrected for variation of emissivity with temperature. From one to eight or more layers of one of the materials were held between two copper disks with a pressure of 6 gm./cm²., one disk being heated electrically by a coil between it and a third disk, and all three radiating to a constant-temperature enclosure. The temperature of the samples was 30 to 40 deg. The values obtained are greater for dense than for loosely woven or knitted samples, ranging from 76 for unspun silk,

94 to 120 for wool, 101 to 122 for silk, 131 for flannelette, 158 to 167 for linen, and 168 to 184 for cotton, all times 10^{-6}. The results come out greater for several layers than for a few, and greater for moist than for dry samples. When the materials are arranged according to conductivity for equal weight instead of equal thickness, the order depends largely on the looseness of texture, beginning with unspun silk, loosely woven wool and knitted artificial silk, and ending with closely woven silk cotton and linen.

The above is a synopsis of a paper which appeared in the November, 1921, issue of *The Physical Review*. Address E. S. Rood, Mount Holyoke College, Mass.

Thermal Conductivity A2-22. Variation with the Temperature of the Thermal Conductivity of Cast Iron. Variation with Temperature of the Thermal Conductivity of Soft Gray Cast Iron, 195 to 542 deg. cent.—The sample used contained 3.5, 2.2 and 0.64 per cent. of C, Si and Mn, respectively, and was cast into the form of a cylindrical shell 3 cm. thick, joined with a hemispherical bottom. The temperature differences between the liquids inside and outside the shell, which amounted to from 3 to 6 deg. with an input of from 0.24 to 1.6 kw., were measured with thermocouples silver-soldered in the ends of brass tubes. Since even though these tubes were pressed against the iron surfaces, the temperatures thus measured differed more or less from the actual temperatures of the surfaces, the absolute values found for the conductivity are too low; but the results indicate that the conductivity at 542 deg. is between 2 and 3 times its value at 195 deg. cent.

A brief but interesting report on this subject is printed in the March, 1922 issue of *The Physical Review*. It records the progress made thus far by Elmer E. Hall of the Department of Physics, University of California, Berkeley, California.

Cement and Other Building Materials A2-22. Method of Proportioning Concrete Materials—Screened and Unscreened Gravel. Bulletin No. 60 just received from the Engineering Experiment Station of Iowa State College. See Synopsis of the Process of Making Concrete.

The conclusions with respect to the theory of proportioning which may be drawn from the numerous strength tests reported in this Bulletin, are: (1) If the consistency remains the same the strength varies with the coarseness of the aggregate, or, for the same consistency, the finer the aggregate the more cement (to maintain the strength), is required: (2) The finer the aggregate the more water is required to produce the required consistency; (3) And, therefore, combining 1 and 2, the more water used in mixing, the more cement is required to maintain the strength. Address R. W. Crum, Iowa State College, Ames, Iowa.

Steel, Its Treatment and Products A2-22. Corrosion of Steels. Laboratory work relating to the determination of the relative resistance of certain alloy steels to corrosion when submitted to combined weathering and immersion in distilled water was completed during the month. Based on exposure of 19 days, the polished samples of steel showed the best resistance to corrosion in the order given below:

1 Annealed stainless steel (C–0.15%, Cr–13%)
2 Annealed high-chromium and high-nickel steels
3 Forged stainless steel
4 Cast-iron-chromium alloy (C–0.04%, Cr–6.5%)
5 Annealed chromium steel (C–0.20%, Cr–8.6%)
6 Annealed chromium steel (C–0.30%, Cr–5.72%)
7 Annealed chromium steel (C–0.28%, Cr–3.90%)
8 Pure iron
9 Iron-carbon alloy (C–0.45%).

These tests have been conducted in the laboratories of the Bureau of Standards, Washington, D. C. Address Dr. S. W. Stratton, Director.

Steel, Its Treatment and Products A3-22. Effect of Heat Treatment on the Mechanical Properties of 1 Per cent Carbon Steel. Technologic Paper No. 206 of the Bureau of Standards on this subject will be ready for distribution by the Superintendent of Documents, Government Printing Office, this city, during the month of March. The price is 15 cents per copy.

This gives the effects of varying time-temperature relations in heat treatment on tensile and impact properties, hardness, and structure of 1 per cent carbon steel, as follows: (*a*) Effect of temperature variations in hardening; (*b*) time of hardening temperatures above Acm between the Ac_1 and Acm transformation; (*c*) effects of tempering steels hardened in different ways and effects of "soaking" just under the lower critical range, and (*d*) comparison of oil and water hardening for production of definite strengths. Under the described conditions of treatment and test, the features observed are described in detail under eight headings.

B—Research in Progress

The purpose of this section of Engineering Research is to bring together those who are working on the same problem for cooperation or conference, to prevent unnecessary duplication of work and to inform the profession of the investigators who are engaged upon research problems. The addresses of these investigators are given for the purpose of correspondence.

Paints, Varnishes and Resins B1-22. Paint on Wood. The National Research Council and the Engineering Foundation are completing arrangements for a thorough research into the protective covering of wood of all kinds. Owing to the nature of some of the tests involved this research will extend over a period of eight to ten years. The plans call for a study in laboratory and field by methods to be devised and improved from time to time, of paints, varnishes and other protectives now commonly used and others which may be suggested, to determine best materials for various purposes, conditions and woods and the most effective methods of application, durability and appearance.

Among objects sought are: (*a*) control of dimensional changes of wood due to absorption and loss of moisture; (*b*) preservation of wood for economic reasons, including conservation of forests; (*c*) economies in use of protective and finish coatings for wood and of the labor required for their application. It is proposed to carry this work forward with the full coöperation of the Forest Products Laboratory of the Department of Agriculture at Madison, Wis., the Bureau of Standards and the American Society for Testing Materials in addition to the lumber, woodworking and paint industries of the country. Address Alfred D. Flinn, Secretary, Engineering Foundation 29, West 39th Street, New York City.

Heat B1-22. Heat of Fusion and Specific Heat of Metals. The Committee on Grants of the American Association for the Advancement of Science has recently assigned one hundred and fifty dollars to Professor A. W. Smith, Ohio State University, Columbus, Ohio, in support of this work on the latent heat of fusion and the specific heat of metals.

Steel, Its Treatment and Products B2-22. Electric Furnace vs. Open-Hearth Silico-Manganese Spring Steels. It is more or less generally recognized that steels of the same composition in so far as the elements used are concerned require variations in heat treatment to produce similar properties. This applies to comparisons between heats made by the same type of process and steels produced by different processes. A series of tests was completed during the past month at the Bureau of Standards on samples of electric and open-hearth heats of silico-manganese spring steels carrying equal proportions of C, Mn, P, S, and Si. The tests included microscopic examination, tensile test, and determination of proportions of certain gases present, particularly nitrogen and hydrogen. In general, the microstructure of the electric steel was somewhat different from that observed in the open-hearth when both steels were subjected to the same heat treatment.

Under certain thermal treatments, distinct differences in tensile properties were observed, but these were largely obliterated by a preliminary normalizing quench from a high temperature. It was found that the proportion of oxygen present in these steels was practically the same, about 0.028 per cent, and independent of the heat treatment applied. The nitrogen in the original rolled samples of electric steel was approximately twice that of the open-hearth and independent of the heat treatment. However, in the case of the electric steel, the proportions of nitrogen were dependent upon the heat treatment.

Iron and Steel B1-22. Iron for Use in Manufacture of Car Wheels. A new investigation has been inaugurated to study the relation between the mechanical composition and physical properties of cast iron of the car-wheel type. In the preliminary work particular attention is to be paid to the question of sulphur and phosphorus content of the iron. The irons will be made in the Ajax-Northrup high-frequency furnace which permits a very close regulation to any desired composition. The following tests will be made on the cast material: Transverse, tensile, impact, hardness, and wear. The depth of the chill of the chilled specimens will also be noted.

This work should prove of great value in the drawing up of specifications for chilled iron car wheels. Address Dr. S. W. Stratton, Director, Bureau of Standards, Washington, D. C.

Welding B1-22. Welding of Street-Railway Joints. The American Electric Railway Association through its Committees on Way Matters initiated the formation of the Committee on Welded Rail Joints for the purpose of having an authoritative investigation made of the various types of welded rail joints now in commercial use. The American Bureau of Welding as the coördinating agency in the general field of welding research and standardization has organized a large Committee comprising over thirty experts on welded rail joints.

Welding is being very widely used in making street-railway joints and more or less trouble has been experienced in all types of welded joints from breakage. Little or no scientific data exists as to correct procedure to be followed in making welds by the various processes. Several of the larger companies are spending many thousands of dollars per year on such joints.

A small Executive Committee has prepared a thorough questionnaire on the four types of welded joints now in use, namely, cast iron, electric seam, resistance and thermit. These were sent out to the members of the Committee and replies are being forwarded to the Society. From the answers to this questionnaire it is expected that a critical summary will be prepared of our present knowledge based upon all the available experience in this field. A program of research will then be outlined and different parts of the program assigned to an appropriate laboratory or in the case of field experiments to one or more appropriate operating companies. These assignments would, of course, cover the men under whom the specific experiments will be conducted. Address Wm. Spraragen, Secretary, American Bureau of Welding, 29 West 39th Street, New York.

Corrosion B1-22. Metallic Corrosion. Realizing the great loss which industry experiences each year as a result of corrosion in its various forms, The National Research Council recently appointed a committee to correlate the activity already under way. It recognizes the start that has been made by committees which are composed of representatives of thirteen organizations associated with a number of large firms and it desires first, to be a clearing-house for research information, and second, to devote its attention to a fundamental scientific study of the subject. Address Dr. Colin G. Fink, Secretary of the Committee, 101 Park Avenue, New York.

Electrolysis B1-22. Metallic Corrosion. See *Corrosion B1-22.*

D—Research Equipment

The purpose of this section of Engineering Research is to give in concise form notes regarding the equipment of laboratories for mutual information and for the purpose of informing the profession of the equipment in various laboratories.

Iron and Steel D1-22. Titanium in Steel and Bronze. The facilities of the Physical Laboratories of the Titanium Alloy Manufacturing Company are now offered to manufacturers and others interested in metallurgical and mechanical lines.

Equipped primarily for research and experimental work of an exacting nature, the apparatus is such as to insure accurate results. The Physical Laboratories are comprised of four units: testing laboratory, metallographic laboratory, room for experimental heat-treating and small experimental foundry.

They are equipped for most of the usual physical tests, such as hardness, tensile, impact, alternating stress, electrical conductivity, etc., etc. In the heat-treating department they are able to do heat-treating of any character, but only on an experimental scale. The experimental foundry is equipped only for work on metals which can be satisfactorily melted in crucibles. The work of these laboratories was one of the prime factors in the development of Aluminum Bronze in this country. Address George F. Comstock, Physical Testing Laboratories, Titanium Alloy Manufacturing Company, Niagara Falls, New York.

E—Research Personnel

The purpose of this section of Engineering Research is to give notes of a personal nature regarding the personnel of various laboratories, methods of procedure for commercial work or notes regarding the conduct of various laboratories.

Research Agencies E3-22. Research Laboratories in Industrial Establishments of the United States. This is the tile of a Bulletin of the National Research Council recently issued by the National Research Council. This publication is a revised and enlarged edition prepared by Ruth Cobb of the Bulletin originally compiled by Alfred D. Flinn, Secretary Engineering Foundation. Following a brief introduction the information is classified in four ways: (*a*) Alphabetical list of laboratories, (*b*) Index to subject classification of laboratories, (*c*) Subject classification of laboratories, (*d*) Address list of directors of research. Address The National Research Council, Washington, D. C.

F—Bibliographies

The purpose of this section of Engineering Research is to inform the profession of bibliographies which have been prepared. In general this work is done at the expense of the Society. Extensive bibliographies require the approval of the Research Committee. All bibliographies are loaned for a period of one month only. Additional copies are available, however, for periods of two weeks to members of the A.S.M.E. These bibliographies are on file at the office of the Society.

Electrochemistry F1-22. Electrolytic Corrosion of Pipe Lines and Structural Materials. A bibliography of 8 1/2 pages. Search 3474.

Fuel Utilization F1-22. The Smoke Problem. An interesting review of the history and technical information relating to smoke abatement is contained in a brief report prepared by O. P. Hood, Chief Mechanical Engineer, U. S. Bureau of Mines. A bibliography on this subject forms part of this Report, No. 2323.

Properties of Engineering Materials F1-22. Platinum. In response to numerous inquiries the Bureau of Mines has prepared a report (No. 2326) on platinum, its properties, uses, occurrence, metallurgy, refining and its substitutes. This report also contains a short bibliography.

WORK OF THE A.S.M.E. BOILER CODE COMMITTEE

The Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the Code is requested to communicate with the Secretary of the Committee, Mr. C. W. Obert, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and passed upon at a regular meeting of the Committee. This interpretation is later submitted to the Council of the Society for approval, after which it is issued to the inquirer and simultaneously published in Mechanical Engineering.

Below are given the interpretations of the Committee in Cases Nos. 384 to 390 inclusive, as formulated at the meeting of March 2, 1922, and approved by the Council. In accordance with the Committee's practice, the names of inquirers have been omitted.

Case No. 384

Inquiry: Is it permissible, under Par. 191, to straighten the edges of bottom plates of fired pressure vessels by hand hammering on an anvil which is bolted to the edges of the sheet where the bottom plate has been cold pressed with sectional dies to the correct radius?

Reply: It is the opinion of the Committee that the straightening of edges of bottom plates of fired pressure vessels by hand hammering is prohibited by Par. 191 of the Code. Attention is called to the fact that with proper dies and manipulation, it is possible to properly form the plate.

Case No. 385

Inquiry: Does the requirement in Par. 6 for the material to be used in braces apply to the structural members referred to in Pars. 201 and 225?

Reply: It is the opinion of the Committee that the structural members referred to in Pars. 201 and 225 come under the classification of braces in Par. 6 and should be of material that conforms to the specification for steel bars.

Case No. 386

Inquiry: Is it the intent of Par. 250 and 251 that expanders of the Prosser type may not be used for attaching tubes and nipples in fire-tube and water-tube boilers, and that expanders of the roller type are compulsory?

Reply: It was the intent of Pars. 250 and 251 to specify that the tubes be suitably expanded by other than a peening process and the exclusion of the use of a Prosser-type expander was not contemplated by the Committee.

Case No. 387

Inquiry: Does the tolerance of 20 per cent in the phosphorus and sulphur limits as given in Par. 84*b* of the Boiler Code permit the acceptance of steel castings with 0.06 per cent of phosphorus and sulphur?

Reply: The to leranceof the phosphorus and sulphur limits as given in Par. 84*b* of the Boiler Code, applies only to the check analysis from the casting, which check analysis is not compulsory, and which is not subject to the tolerance. The reason is that the ladle analysis gives a fair average of the constituents of the steel, whereas locally in the casting, the chemical constituents may vary slightly from the average; hence the tolerance permitted.

Case No. 388

Inquiry: Would a continuous feed pipe, which is connected so as to pass lengthwise through a boiler drum with feed valves at each end of the pipe, the pipe being drilled with a number of holes 1/2 in. in diameter or over, spaced along its length for discharging the water into the drum, the combined area of the holes being at least equal to that of the cross-section of the pipe, be acceptable under the requirements of Par. 314 of the Code?

Reply: It is the intent of Par. 314 of the Code, that the feed pipe

of the boiler shall have an open end or ends inside the boiler, and it is the opinion of the Committee that the arrangement submitted is the equivalent of an open-ended pipe and should be allowed. (See Case No. 358.)

CASE No. 389

Inquiry: Is it the intent of the last sentence of Par. 308 of the Code to restrict the use of globe valves of the angle type for blow-off connections? It was pointed out that angle globe valves have a practically straightway passage through them and offer no dam or obstruction to cause accumulation of sediment.

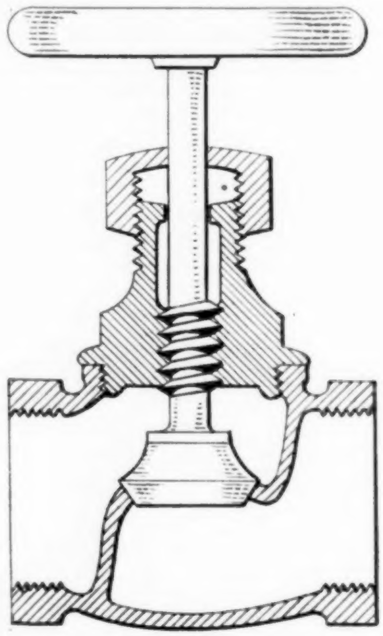
Reply: It was the intent of Par. 308 that straightway globe valves of the ordinary type or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections. Accordingly, a revision of the last sentence of Par. 308 has been suggested to read as follows:

> Straightway globe valves of the ordinary type as shown in the accompanying illustration, or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections.

CASE No. 390

Inquiry: Would it be permissible, under the rules in the Code to construct an electrical steam generator formed of large electrodes immersed in water within an enclosed vessel, for producing steam at 100 lb. gage pressure from electrical energy? The generator is to have a circular shell of a size in excess of the miniature boiler limit in outside diameter, with flat cast-steel head having the necessary openings for access, bolted to cast-steel flanges riveted to the circular shell.

Reply: Such a construction is not fully covered by the Code. In view of the impossibility of computing these strains in the flat circular heads with exactness when it is desired to build boilers of this type, the Committee would recommend that a test to destruction be made on a full-sized generator as provided for in Par. 247 of the Code.



TYPE OF GLOBE VALVE REFERRED TO IN PAR. 308 OF BOILER CODE

RULES FOR THE CONSTRUCTION OF MINIATURE BOILERS

FOR over two years a Sub-Committee of the Boiler Code Committee has been engaged in formulating Rules for the Construction of the so-called Miniature Boilers, which is to form Section 5, Part 1 of the A.S.M.E. Boiler Code. There has been considerable demand for such a Code embodying special rules for boilers of small size that come within this classification in which the requirements for power boilers of average size are scarcely necessary or justified. Several preliminary reports upon this Code have been considered by the Boiler Code Committee and two revisions thereof have been submitted to the steam boiler industry for purposes of discussion. In connection with the 1921 Annual Meeting of the Society, a public hearing on the proposed rules was held and the manufacturers were there invited to discuss the proposed regulations. The report is here published for the information of the membership. Anyone desiring to discuss the report is requested to address the Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y.

A.S.M.E. Boiler Code

PART I SECTION 5

RULES FOR THE CONSTRUCTION OF MINIATURE BOILERS

M-1 *Definition.* Boilers to which the classification "Miniature" applies, embrace fired pressure vessels which do not exceed the following limits:

16 in. inside diameter of shell
42 in. length of shell
20 sq. ft. total heating surface
100 lb. per sq. in. maximum allowable working pressure.

Where any one of the above limits is exceeded, the rules for Power Boilers shall apply.

M-2 Specifications are given in these Rules, Pars. 23–178 of Part I, Section 1 of the Code, for the important materials used in the construction of boilers, and the materials for miniature boilers, for which specifications exist, shall conform thereto, except that in lieu of definite specifications for boiler-plate material, there may be used for the shells or drums of miniature boilers, seamless drawn shells with integral heads, or seamless or extra heavy lap-welded steel or iron pipe or tubing, provided it is of open-hearth material and the weld is formed by the forging process. Owing to the small size of the parts of miniature boilers, stamping as required by Par. 36 of the Rules for Power Boilers need not be visible after completing the boiler, provided the manufacturer certifies on the data slip accompanying the boiler that the material is in accordance with the requirements of the A.S.M.E. Code for Miniature Boilers. Provisions shall be made by the manufacturer whereby he shall be able to supply complete information regarding the material and details of construction of any boiler built under the Miniature Boiler Code.

M-3 Steel plate when used for any part of a miniature boiler where under pressure, shall be of the firebox or flange grades, but in no case shall steel of less than $^{1}/_{4}$ in. thickness be used for riveted shells or less than $^{3}/_{16}$ in. thickness for seamless shells. The heads, if used as tube sheets with tubes rolled in, shall be at least $^{5}/_{16}$ in. thick.

M-4 The construction of miniature boilers, except where otherwise specified, shall conform to that required for power boilers. The factor of safety and method of computing the maximum allowable working pressure shall be the same as for power boilers.

M-5 Heads or parts of miniature boilers when not exposed to the direct action of the fire may be made of cast iron or malleable iron provided it complies with the requirements in Part I, Section 1 of the Boiler Code for the headers of water-tube boilers.

M-6 Steam-generator elements of not over 600 cu. in. in volume may be made of cast copper or bronze having a copper content of not less than 90 per cent and wall thickness of not less than $^{1}/_{4}$ in. Such generators shall be equipped with at least two brass washout plugs of not less than 1-in. iron-pipe size, and shall be tested to a hydrostatic pressure of 600 lb. per sq. in.

M-7 Circumferential riveted joints, where used, shall conform to the requirements in Par. 184 of Part I, Section 1 of the Code. Autogenous welding may be used for joints in miniature boilers where the strain is carried by other construction which conforms to

the requirements of the Code and where the safety of the structure is not dependent upon the strength of the weld.

M-8 Tubes may be made of wrought iron, steel, drawn copper or drawn brass. Fire tubes $1^1/_2$ in. and over shall have both ends substantially expanded into the tube sheet by rolling and beading. Fire tubes less than $1^1/_2$ in. shall be expanded and beaded, or expanded and welded. The gage of the tubes shall not be less than that specified for water-tube boilers and fire-tube boilers as specified in Pars. 21 and 22 of Part I, Section 1 of the Code.

M-9 All rivet holes shall be drilled full size, or they may be punched not to exceed $^1/_8$ in. less than full diameter and then drilled or reamed to full diameter.

M-10 The calking edges of plates, buttstraps and heads shall be beveled to an angle not sharper than 70 deg. to the plane of the plate, and as near thereto as practicable. Every portion of the sheared surfaces of the calking edges shall be planed, milled or chipped to a depth of not less than $^1/_8$ in. Calking shall be so done that there is no danger of scoring or damaging the plate underneath the calking edge, or splitting the edge of the sheet.

M-11 Every miniature boiler shall be fitted with not less than three brass washout plugs of 1-in. iron-pipe size, which shall be screwed into openings in the shell near the bottom, reinforced to give four full threads. All threaded openings in the boiler shell shall be provided with a riveted or welded reinforcement if necessary, to give four full threads therein.

M-12 Every miniature boiler shall be provided with at least one feed pump or other feeding device, except where it is connected to a water main carrying sufficient pressure to feed the boiler.

M-13 Each miniature boiler shall be fitted with feedwater and blow-off connections, which shall not be less than $^1/_2$-in. iron-pipe size. The feed pipe shall be provided wth a check valve and a stop valve. The feedwater may be delivered to the boiler through the blow-off connection, if desired. The blow-off shall be fitted with a valve or cock in direct connection with the lowest water space practicable.

M-14 Each miniature boiler for operation with a definite water level shall be equipped with a glass water gage for determining the water level. The lowest, permissible water level shall be at a point one-third of the height of the shell, except where boiler is equipped with internal furnace, when it shall be not less than one-third of the length of the tubes above the top of the furnace.

M-15 Each miniature boiler shall be equipped with a steam gage, having dial graduated to not less than one and one-half times the maximum allowable working pressure. The gage shall be connected to the steam space or to the steam connection to the water column, by a siphon tube or equivalent device that will keep the gage tube filled with water.

M-16 Each miniature boiler shall be equipped with a sealed spring-loaded pop safety valve, not less than $^1/_2$ in. diameter, connected direct to the boiler, independent of any other connection. The safety valve shall be plainly marked by the manufacturer with a name or an identifying trademark, the nominal diameter, the steam pressure at which it is set to blow, and A.S.M.E. Std. The minimum relieving capacity shall be determined on the basis of 3 lb. of steam per hour per square foot of boiler heating surface.

M-17 Each steam line from a miniature boiler shall be provided with a stop valve located as close to the boiler shell or drum as is practical.

M-18 Where miniature boilers are gas-fired, the burners used shall conform to the requirements of the American Gas Association, as given in the Appendix. The burners shall in such cases be equipped with a fuel-regulating governor, which shall be automatic and regulated by the steam pressure. This governor shall be so constructed that in the event of its failure, there can be no possibility of steam from the boiler entering the gas chamber or supply pipe.

M-19 All boilers referred to in this section shall be plainly marked with the manufacturer's name, the maximum allowable working pressure which shall be indicated in arabic numerals, followed by the letters "lb.," and the serial number. All boilers built according to these rules shall be marked A.S.M.E. Min. Std. Individual shop inspection is not required for miniature boilers.

A data sheet shall be filled out for each boiler and signed by the manufacturer, this data sheet to include the most important items and to be numbered. In addition to this, the complete data sheet required for power boilers shall be filled out and preserved by the manufacturer for each lot of steel and each lot of boilers manufactured therefrom. The complete data sheet shall be marked to indicate to which boilers it applies and the manufacturer shall furnish copies of this complete data sheet when requested to do so by the owner of any one of the boilers. In requesting the complete data sheet the owner should forward the number of the boiler which would be stamped thereon in order that the manufacturer may readily identify the complete data sheet applying to the boiler.

(Name of manufacturer)
....
60 lb.
A.S.M.E. Min. Std.

Sample of Marking

(As required by the Provisions of the A.S.M.E. Code Rules)

As Required by the Provisions of the A.S.M.E. Code Rules

1. Manufactured by..
   (Name and address of the manufacturer)

2. Manufactured for..... ....
   (Name and address of the purchaser)

3. Type.....Boiler No.(........)(.........)(.........) Yr. built
   (Manufr's. Serial No.) (State and State No.) (A.S.M.E. No.)

   Diameter of Length of
4. Shell or Drums..........Drums......overall......ft......in.
   (Inside of outside course)

   Material for Shell, Straps
5. Heads and Furnace Sheets made by......... (If more than one make, give names of manufacturers in same order as parts referred to.)

   Has material used in boiler been checked with mill test reports...
6. Built for maximum allowable working pressure..........lb.
7. Hydrostatic pressure applied..........................lb.

   Note: The mill test reports of tests of material used in this boiler are preserved by the manufacturer as well as all data applying to the boiler called for in the data sheet for Power Boilers. This data will be supplied by the manufacturer at the request of the owner of the Boiler.
8. Openings: No...Size...in., No....Size...in., No....Size..in.
   (Main Steam connections) (Safety valve) (Blow-off)

....
(Inspector of Boilers for State or Boiler Insurance Companies)

APPENDIX

Gas Burner Specifications—American Gas Association

Each burner shall be equipped as follows:

1 With a separate one-quarter-turn gas cock
2 With either an adjustable gas orifice or a removable brass orifice of a fixed drilling to meet the local condition
3 With an adjustable air shutter capable of giving complete shut off; a lock washer or screw should hold the shutter so securely that accidental shifting of the shutter is impossible
4 The mixing tube should be at least six times as long as its minimum diameter
5 When the air mixer, mixing tube and burner are made in separate parts, they shall assemble so that there is no reduction in internal area at the point of their connection in the direction of the gas flow.

The burner proper shall preferably be of a one-piece cored casting.

The port openings shall be drilled, or if assembled, shall be of uniform size.

The burner shall be capable of operating satisfactorily without a wire gauze.

For satisfactory operation a burner should have sufficient flexibility to burn with a blue flame at full load and not flash back when shut down to the gas flow required to just maintain radiation losses.

A positive pilot-lighting burner shall be provided.

Sectional Committee on Standardization of Gears Proposes Five Standards

THE decision to organize this Sectional Committee under the Rules of the American Engineering Standards Committee was announced in the September, 1920 issue of MECHANICAL ENGINEERING. It was there stated that the American Gear Manufacturers Association and The American Society of Mechanical Engineers had been designated Sponsors for this Committee by the A.E.S.C.

At the first meeting held on June 23, 1921 Mr. Benjamin F. Waterman was elected chairman, Mr. Earle Buckingham, vice chairman, and Mr. John P. Kottcamp, secretary. The field in which this Committee is to work was looked over in a general way and Mr. Buckingham was asked to prepare for the use of the members of the Committee a review of the Present Status of Gear Standardization in the United States and Europe. A copy of this statement with reprints of all known gear standards was then placed in the hands of each member of the Committee before the next meeting which was called for October 27, 1921. A third meeting was held on January 19, 1922.

Owing very largely to the excellent preliminary work in this field which the American Gear Manufacturers Association has carried on for a number of years the Sectional Committee is now able to submit a Preliminary Report covering five sub-divisions of its work, namely, (a) Gears and Pinions for Electric Railway Service, (b) Gray-Iron Industrial Spur Gears, (c) Specifications for Forged and Rolled Gear Steels, (d) Specifications for Steel Castings for Gears and (e) Standard Specifications for Brass and Bronzes for gears.

Two reasons prompt the Sectional Committee to publish these proposed standards at this time: *First*, it desires at all times to keep the public fully informed concerning the progress of its work and *second*, it needs the constructive criticism and suggestions of those most interested in the subject. Kindly address the Secretary of the Committee Mr. John P. Kottcamp, care of Pratt Institute, Brooklyn, N. Y. After a reasonable time has elapsed the Sectional Committee will formally present these standards to the two sponsor bodies, who will, on approval, place them before the American Engineering Standards Committee.

Gears and Pinions for Electric Railway Service

CASE-HARDENED FORGED-STEEL GEARS

MANUFACTURE

1 *Material.* All blanks for gears shall be made from open-hearth steel which has been thoroughly worked to secure a homogeneous dense material, free from all injurious defects.

CHEMICAL PROPERTIES AND TESTS

2 *Chemical Properties.* The steel shall conform to the following requirements as to chemical composition.

Carbon.....0.20 per cent, not less than 0.12 per cent nor more than 0.28 per cent.

Manganese..0.50 per cent, not less than 0.40 per cent nor more than 0.60 per cent.

Phosphorus.....not over 0.05 per cent.

Sulphur........not over 0.05 per cent.

3 *Check Analysis.* A check analysis may be made by the purchaser or his representative from one or more gear blanks from each lot of 100 or fraction thereof ordered and this analysis shall conform to the requirements specified above. Sample for check analysis to be taken at the pitch line so that the blank will not be destroyed.

PHYSICAL PROPERTIES AND TESTS

4 *Hardness.* The hardness as shown by the scleroscope shall not be less than eighty, taken at the center of the top of the tooth after treatment.

5 *Treatment.* All gears, after the teeth are cut, shall be carbonized to a depth approximately one-sixth of the thickness of the teeth on the pitch line.

DIMENSIONS AND FINISH

(See Fig. 1)

6 *Diameter.* The outside diameter (A) over the teeth as machined must not vary from that specified by a more than plus zero (0) inch or minus one thirty-second (1/32) inch.

7 *Face.* (*a*) The face (B) of the gears must not vary from the specified width by more than plus one thirty-second (1/32) in. or minus one thirty-second (1/32) in.

(*b*) The minimum thickness of the rim (C) under the teeth shall be as follows, measured one-eighth (1/8) in. from the edge of the rim:

Pitch	Thickness of Rim
3	3/8 in.
2½	7/16 in.
2	½ in.

8 *Web.* The Web (D) of all gears shall have four $3\frac{1}{2}$ in. holes

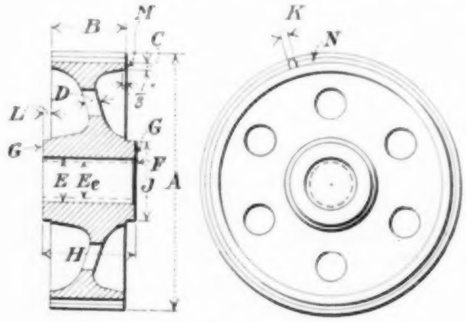


FIG. 1

on $7\frac{1}{4}$ in. radius spaced with a tolerance of one-eighth (1/8) in. in center of webbed section, whenever the space will permit.

9 *Bore.* (*a*) The diameter of finished bore (E) shall not vary from that specified by more than plus one-thousandth (0.001) in. or minus one and one-half thousandths (0.0015) in.

(*b*) The diameter of rough bore (Ee) shall not vary more than one-sixteenth (1/16) in. over or one-eight (1/8) under that specified.

(*c*) The ends of finished bores shall be chamfered (F) one-sixteenth (1/16) in. on motor side to avoid injury to shaft when mounting.

(*d*) Bore shall be measured with a pin gage or inside micrometer.

10 *Hub.* (*a*) The face (G) of hub (H), next to lining, shall have a smooth-bearing finish and run true with bore.

(*b*) The variation from the specified dimensions of hub (H) and hub extension (L) shall not exceed the following:

Length of hub (H) overall plus zero (0) in. to minus two-hundredths (0.02) in.

Length of hub extension (L) plus one thirty-second (1/32) in. to minus one thirty-second (1/32) in.

Diameter of hub extension (J) plus zero (O) in. to minus three hundredths (0.03) in.

11 *Teeth.* (*a*) The thickness (K) of teeth at the pitch line must be to specified dimensions as a maximum or to specified dimensions minus ten-thousandths (0.010) in. as a minimum.

(*b*) The teeth shall be of the Brown and Sharpe standard $14\frac{1}{2}$ degree involute form unless otherwise specified.

MARKING

12 *Marking.* The information indicated by the following list shall be plainly stamped on motor side of rim (N) of all gears; (*a*) Grade; (*b*) Month, (*c*) Year; (*d*) Serial Number of Manufacturer, (consecutive for each month); (*e*) Name, (initials or trade mark of manufacture).

INSPECTION AND REJECTION

13 *Inspection.* (*a*) All gears shall be tested for smooth running.

The teeth must be equally spaced so that the gear will run smoothly in both directions with a master pinion.

(*b*) Records of all chemical analysis and physical tests shall be kept by the manufacturer and shall be available to the purchaser for a period of one year.

14 *Rejection.* The purchaser should reserve the right to reject any portion of or all of the material which does not conform to the above specifications in every particular.

QUENCHED AND TEMPERED FORGED CARBON-STEEL GEARS

Manufacture

15 *Material.* All blanks for gears shall be made from open-hearth steel which has been thoroughly worked to secure a homogeneous dense material, free from all injurious defects.

Chemical Properties and Tests

16 *Chemical Properties.* The steel shall conform to the following requirements as to chemical composition.

Phosphorus.......not over 0.05 per cent.
Sulphur..........not over 0.05 per cent.

17 *Check Analysis.* A check analysis may be made by the purchaser or his representative from one or more gear blanks from each lot of 100 or fraction thereof ordered and this analysis shall conform to the requirements specified above. The sample for check analysis to be taken at the pitch line so that the blank will not be destroyed.

Dimensions and Finish

(See Fig. 1)

18 *Diameter.* The outside diameter (A) over the teeth as machined must not vary from that specified more than plus zero (0) in. or minus one thirty-second (1/32) in.

19 *Face.* (*a*) The face (B) of the gears must not vary from the specified width by more than plus one thirty-second (1/32) in. or minus one thirty-second (1/32) in.

(*b*) The minimum thickness of the rim (C) under the teeth shall be as follows, measured one-eighth (1/8) in. from the edge of the rim:

Pitch	Thickness of Rim
3	3/8 in.
$2\frac{1}{2}$	7/16 in.
2	$\frac{1}{2}$ in.

20 *Web.* The web (D) of all gears shall have four $3\frac{1}{2}$ in. holes on $7^1/_4$ in. radius spaced with a tolerance of one-eighth (1/8) in. in center of webbed section, whenever the space will permit.

21 *Bore.* (*a*) The diameter of finished bore (E) shall not vary from that specified by more than plus one-thousandth (0.001) in. or minus one and one-half thousandths (0.0015) in.

(*b*) The diameter of rough bore (Ee) shall not vary more than one-sixteenth (1/16) in. over or one-eight (1/8) under that specified.

(*c*) The ends of finished bores shall be chamfered (F) one-sixteenth (1/16) in. on motor side to avoid injury to shaft when mounting.

(*d*) Bore shall be measured with a pin gauge or inside micrometer.

22 *Hub.* (*a*) The face (G) of hub (H) next to lining shall have a smooth-bearing finish and run true with bore.

(*b*) The variation from the specified dimensions of hub (H) and hub extension (L) shall not exceed the following:

Length of hub (H) overall plus zero (0) in. to minus two-hundredths (0.02) in.

Length of hub extension (L) plus one thirty-second (1/32) in. to minus one thirty-second (1/32) in.

Diameter of hub extension (J) plus zero (0) in. to minus three hundredths (0.03) in.

23 *Teeth.* (*a*) The thickness (K) of teeth at the pitch line must be to specified dimensions as a maximum or to specified dimensions minus ten-thousandths (0.010) in. as a minimum.

(*b*) The teeth shall be of the Brown and Sharpe standard $14^1/_2$ degree involute form unless otherwise specified.

Marking

24 *Marking.* The information indicated by the following list shall be plainly stamped on motor side of rim (N) of all gears; (*a*) Grade; (*b*) Month; (*c*) Year; (*d*) Serial Number of Manufacturer, (consecutive for each month); (*e*) Name (initials or trade mark of manufacturer).

Inspection and Rejection

25 *Inspection.* (*a*) All gears shall be tested for smooth running. The teeth must be equally spaced so that the gear will run smoothly in both directions with a master pinion.

(*b*) Records of all chemical analysis and physical tests shall be kept by the manufacturer and shall be available to the purchaser for a period of one year.

26 *Rejection.* The purchaser reserves the right to reject any portion of or all of the material which does not conform to the above specifications in every particular.

CASE-HARDENED FORGED-STEEL PINIONS

Manufacture

27 *Material.* All blanks for pinions shall be made from open-hearth steel which has been thoroughly worked to secure a homogeneous dense material, free from all injurious defects.

Chemical Properties and Tests

28 *Chemical Properties.* The steel shall conform to the following requirements as to chemical composition.

Carbon.....0.20 per cent, not less than 0.12 per cent nor more than 0.28 per cent.
Manganese..0.50 per cent, not less than 0.40 per cent nor more than 0.60 per cent.
Phosphorus.....not over 0.05 per cent.
Sulphur........not over 0.05 per cent.

29 *Check Analysis.* A check analysis may be made by the purchaser or his representative from one or more pinion blanks from each lot of 100 or fraction thereof ordered and this analysis shall conform to the requirements specified above. The sample for check analysis to be taken at the pitch line so that the blank will not be destroyed.

Physical Properties and Tests

30 *Hardness.* The hardness as shown by the scleroscope shall not be less than eighty, taken at the center of the top of the tooth after treatment.

31 *Treatment.* All pinions, after the teeth are cut, shall be carbonized to a depth approximately one-sixth (1/6) of the thickness of the tooth on the pitch line.

Dimensions and Finish

(See Fig. 2)

32 *Diameter.* The outside diameter (A) of the pinion shall not vary from that specified by more than plus zero (0) in. or minus one thirty-second (1/32) in. measured at the center of the face.

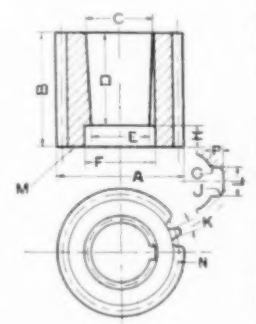


Fig. 2

33 *Face.* The face (B) of the pinion must not vary from the specified width by more than plus or minus one thirty-second (1/32) in.

34 *Bore.* All bores (C–E) must be finished after treatment. The diameter of the bore must be such that the standard plug gauge will not project less than one thirty-second (1/32) in. or more than one-sixteenth (1/16) in. measured at the large end of bore (C) and have bearing the full length of (D) of bore (C–E).

35 *Counterbore.* (*a*) The depth (H) of the counterbore must not vary from that specified by more than plus zero (0) in. or minus one thirty-second (1/32) in.

(*b*) The diameter (F) of the counterbore must not vary from that specified by more than plus one thirty-second (1/32) in. or minus zero (0) in.

36 *Keyway.* (*a*) The sides (G) of the keyway must be cut parallel with the centerline of pinion.

(*b*) The width (L) of the keyway must not vary from that

specified by more than plus three thousandths (0.003) in. or minus zero (0) in.

(*c*) The depth (P) of the keyway must not vary from that specified by more than plus one sixty-fourth (1/64) in. or minus zero (0) in.

(*d*) The fillet (J) at the bottom of the keyway shall have one-sixteenth (1/16) in. radius. With this specification one-sixteenth (1/16) in. clearance shall be provided between bottom of keyway and pinion key.

37 *Teeth.* (*a*) The thickness (K) of teeth at the pitch line must be to specified dimensions as a maximum or to specified dimensions minus ten thousandths (0.010) in. as a minimum.

(*b*) The teeth shall be of Brown and Sharpe standard $14^1/_2$ degree involute form unless otherwise specified.

Marking

38 *Marking.* The information indicated by the following list shall be plainly stamped, preferably on the outer end (M), of pinions; (*a*) Grade; (*b*) Month, (*c*) Year, (*d*) Manufacturer's Serial Number (consecutive for each month), (*e*) Name (initials or trade-mark of manufacturer).

Inspection and Rejection

39 *Inspection.* (*a*) All pinions shall be tested for smooth running. The teeth must be equally spaced so that they will run smoothly in both directions with a master gear.

(*b*) All pinions shall be gaged with a standard taper plug gage, which shall be the same size as the nominal size of the bore at the large end.

(*c*) All pinions shall be free from any seams, cracks or other defects that would in any way affect their service.

40 *Rejection.* The purchaser should reserve the right to reject any portion of or all of the material, which does not conform to the above specifications in every particular.

QUENCHED AND TEMPERED FORGED CARBON-STEEL PINIONS

Manufacture

41 *Material.* All pinions shall be made from blanks of open-hearth steel which have been thoroughly worked to secure a homogeneous dense material, free from all injurious defects.

Chemical Properties and Tests

42 *Chemical Properties.* The steel shall conform to the following requirements as to chemical composition:

Phosphorus.....not over 0.05 per cent.
Sulphur........not over 0.05 per cent.

43 *Check Analysis.* A check analysis may be made by the purchaser or his representative from one or more pinion blanks from each lot of 100 or fraction thereof ordered and this analysis shall conform to the requirements specified above. The sample for check analysis to be taken at the pitch line so that the blank will not be destroyed.

Dimensions and Finish

(See Fig. 2)

44 *Diameter.* The outside diameter (A) of the pinion shall not vary from that specified by more than plus zero (0) inch. or minus one thirty-second (1/32) in. measured at the center of the face.

45 *Face.* The face (B) of the pinion must not vary from the specified width by more than plus or minus one thirty-second (1/32) in.

46 *Bore.* All bores (C–E) must be finished after treatment. The diameter of the bore must be such that the standard plug gage will not project less than one thirty-second (1/32) in. or more than one-sixteenth (1/16) in. measured at the large end of bore (C) and have bearing the full length of (D) of bore (C–E).

47 *Counterbore.* (*a*) The depth (H) of the counterbore must not vary from that specified by more than plus zero (0) in. or minus one thirty-second (1/32) in.

(*b*) The diameter (F) of the counterbore must not vary from that specified by more than plus one thirty-second (1/32) in. or minus zero (0) in.

48 *Keyway.* (*a*) The sides (G) of the keyway must be cut parallel with the centerline of pinion.

(*b*) The width (L) of the keyway must not vary from that specified by more than plus three thousandths (0.003) in. or minus zero (0) in.

(*c*) The depth (P) of the keyway must not vary from that specified by more than plus one sixty-fourth (1/64) in. or minus zero (0) in.

(*d*) The fillet (J) at the bottom of the keyway shall have one-sixteenth (1/16) in. radius. With this specification one-sixteenth (1/16) in. clearance shall be provided between bottom of keyway and pinion key.

49 *Teeth.* (*a*) The thickness (K) of teeth at the pitch line must be to specified dimensions as a maximum or to specified dimension minus ten thousandths (0.010) in. as a minimum.

(*b*) The teeth shall be of Brown and Sharpe standard $14^1/_2$ degree involute form unless otherwise specified.

Marking

50 *Marking.* The information indicated by the following list shall be plainly stamped, preferably on the outer end (M), of all pinions; (*a*) Grade; (*b*) Month; (*c*) Year; (*d*) Manufacturer, Serial Number of (consecutive for each month); (*e*) Name (initials or trademark of manufacturer).

Inspection and Rejection

51 *Inspection.* (*a*) All pinions shall be tested for smooth running. The teeth must be equally spaced so that they will run smoothly in both directions with a master gear.

(*b*) All pinions shall be gaged with a standard taper plug gage, which shall be the same size as the nominal size of the bore at the large end.

(*c*) All pinions shall be free from any seams, cracks or other defects that would in any way affect their service.

52 *Rejection.* The purchaser should reserve the right to reject any portion of or all of the material, which does not conform to the above specifications in every particular.

Gray-Iron Industrial Spur Gears

Dimensions

1 *Face.* The width of face for industrial spur gears shall be determined by dividing the diametral pitch into 10.

It is recommended that the values given in the following table be used as standard since they agree closely with those obtained by the formula.

Diametral Pitch	Face (In.)	Diametral Pitch	Face (In.)
1	10	4	2½
1¼	8	5	2
1½	7	6	1¾
1¾	6	7	1½
2	5	8	1¼
2¼	4½	10	1
2½	4	12	⅞
2¾	3¾	14	¾
3	3½	16	⅝
3½	3	18	½
		20	½

2 *Rim.* The thickness of rim for spoked spur gears of gray iron for industrial work shall be determined by dividing the diametral pitch into 4, or by multiplying the circular pitch by 1.3.

Standard Specifications for Forged and Rolled Steels for Gears

The fifteen steels whose specifications are here proposed for adoption as standards for the gear industry cover the full range of requirements, since, with suitable modifications of heat treatment, it will not be found necessary to go outside this list to secure the physical properties that may be required in the manufacture of gears.

While the table gives all the essential information the following explanatory notes will serve to describe briefly the properties and special uses of the various steels. The specifications are in general similar to those prepared by the Society of Automotive Engineers.

The silicon in all cases is within the limits of 0.10 to 0.25 per cent, while the vanadium for the last three steels listed carries no upper limit. The desired amount is 0.18 per cent.

Where the open-hearth process is specified it is understood that the electric process is an acceptable alternative, but the reverse is not true.

Standard Specifications for Rolled and Forged Steels for Gears

No.	Carbon	Manganese	Phosphorus	Sulphur	Nickel	Chrome	Vanadium	Process
1015	0.10–.20	0.30–.60	Max. 0.045	Max. 0.05				Open Hearth
1020	0.15–.25	0.30–.60	" 0.045	" 0.05				O. H.
1030	0.25–.35		" 0.045	" 0.05				O. H.
								O. H.
1046	0.40–.50	0.30–.50	" 0.045	" 0.05				O. H.
2315	0.10–.20	0.30–.60	" 0.04	" 0.045	3.25–3.75			O. H.
2345	0.40–.50	0.50–.80	" 0.04	" 0.045	3.25–3.75			O. H.
2350	0.45–.55	0.50–.80	" 0.04	" 0.045	3.25–3.75			O. H.
3115	0.10–.20	0.30–.60	" 0.04	" 0.04	1. –1.5	0.45– .75		O. H.
3215	0.10–.20	0.30–.60	" 0.04	" 0.04	1.5—2.	0.90–1.25		O. H.
3245	0.40–.50	0.30–.60	" 0.04	" 0.04	1.5—2.	0.90–1.25		O. H.
3312	Max.–.17	0.30–.60	" 0.04	" 0.04	3.25–3.75	1.25–1.75		Electric
3340	0.35–.45	0.30–.60	" 0.04	" 0.04	3.25–3.75	1.25–1.75		E.
6120	0.15–.25	0.50–.80	" 0.04	" 0.04		0.80–1.10	0.15 min.	O. H.
6145	0.40–.50	0.50–.80	" 0.04	" 0.04		0.80–1.10	0.15 min.	O. H.
6150	0.45–.55	0.50–.80	" 0.04	" 0.04		0.80–1.10	0.15 min.	O. H.

No. 1015 is a low-carbon machinery steel for use in the case-hardened state only, as it is too soft for durable gears unless carbonized. A combination of low carbon and low manganese in this steel also give a core too soft to support heavy loads unless the case is thick. This steel is intended for use particularly in gears of small light sections.

No. 1020 is a low-carbon machinery steel of good quality and low enough in carbon to case harden well. While this is one of the most widely used of gear steels, warning is given to users that a combination of carbon near the high limit and manganese also near the high limit gives a steel which is not desirable for case-hardening use in small cross sections. To avoid this danger, and as the carbon generally tends toward the upper limit, the previous steel No. 1015 is preferable for the small sections and No. 1020 for heavy sections.

No. 1030 is medium-carbon machinery steel of extra good quality, too high in carbon to be case hardened and intended primarily for use in its untreated state, so far as gear work is concerned. For pinions it is suitable to mate with cast-iron gears.

No. 1046 is machinery steel of high enough carbon to be satisfactorily hardened, yet not so high in carbon and manganese as to cause risk when water quenching. This is a development from and an improvement on S.A.E. No. 1045 for gear purposes.

No. 2315 is a low-carbon, 3½ per cent nickel steel for case hardening.

No. 2345 is a 3½ per cent nickel steel of high enough carbon to be hardened directly. This and its companion steel, No. 2315, are very widely known and need no comment.

No. 2350 is a similar 3½ per cent nickel steel with higher carbon, giving better hardening qualities on gears of heavy section. For light sections No. 2345 is preferable.

No. 3115 is a low-carbon chrome-nickel steel suitable for case hardening. It is cheaper and easier to machine than those which follow.

No. 3215 is medium-chrome-nickel steel suitable for case hardening.

No. 3245 is medium-chrome-nickel steel, the companion to the above, but with high enough carbon to harden directly. This is an excellent steel which has recently been adopted by the S.A.E. at the suggestion of the A.G.M.A.

No. 3312 is a high-chrome-nickel steel suitable for case hardening. It is peculiar in having no low limit on carbon, but practically the carbon runs 0.09 per cent at the lowest. Both this and its companion steel, No. 3340, are capable of very fine results, but require careful handling. Note that they are limited to the electrical process of manufacture, though, of course, no exception would be taken to the crucible process.

No. 3340 is a high-chrome-nickel steel similar to the above, but with carbon enough to harden directly. It is subject to the same comments.

No. 6120 is a low-carbon-chrome vanadium steel suitable for case hardening. In this and the two following the desired vanadium is 0.18 per cent, with no definite maximum, only the minimum being rigidly specified.

No. 6145 is similar steel, with carbon enough to harden directly, and recommended for light sections.

No. 6150 is a similar steel with 0.05 per cent more carbon, which enables it to be hardened to give somewhat higher physical properties, especially needed on gears of heavy section.

Standard Specifications for Steel Castings for Gears

For Steel Castings the Section Committee recommends the adoption of the specifications previously developed by the American Society for Testing Materials (A-27-21) with the following modifications:

(1) Paragraph 5 (a):—Add the sentence, "All gear castings must be properly annealed."

(2) Paragraphs 20 to 24 be omitted, as they apply only to ship and railway castings.

Class A castings under this specification are ordinary castings for which no physical requirements are specified. The great majority of gear castings fall in this class. These castings must, however, conform to the requirements of the following chemical composition:

Carbon............not over 0.30 per cent
Phosphorus by acid process... 0.07 per cent
Phosphorus by basic process.. 0.06 per cent
Sulphur.................... not limited

Standard Specifications for Brass and Bronze for Gears

1 *Spur and Bevel Gears.* For Spur and Bevel Gears, hard-cast bronze, S.A.E. specification No. 62 of the well-known 88 copper-10 tin-2 zinc mixture to the following limits:

Copper...................86 to 89 per cent
Tin...................... 9 to 11 per cent
Zinc..................... 1 to 3 per cent
Lead, max....................0.20 per cent
Iron, max....................0.06 per cent

Good castings made from this bronze should give the following minimum physical characteristics:

Ultimate strength..........30,000 lb. per sq. in.
Yield point................15,000 lb. per sq. in.
Elongation in 2 in.................14 per cent

2 *Worm Gears.* For Bronze Worm Gears, two alternative analyses of phosphor bronze, both S.A.E. specifications, Nos. 65 and 63, are recommended.

S.A.E. No. 65 (Called Phosphor-Gear Bronze)

Copper.....................88 to 90 per cent
Tin........................10 to 12 per cent
Phosphorus................. 0.1 to 0.3 per cent
Lead, zinc and impurities, max. 0.5 per cent

Good castings made of this alloy should give the following minimum characteristics:

Ultimate strength..........35,000 lb. per sq. in.
Yield point................20,000 lb. per sq. in.
Elongation in 2 in................10 per cent

S.A.E. No. 63, Called Leaded Gun Metal

Copper....................86 to 89 per cent
Tin....................... 9 to 11 per cent
Lead...................... 1 to 2.5 per cent
Phosphorus, max..................0.25 per cent
Zinc and impurities, max..........0.50 per cent

The following minimum physical characteristics may be expected from good castings of this alloy:

Ultimate strength..........30,000 lb. per sq. in.
Yield point................12,000 lb. per sq. in.
Elongation in 2 in................10 per cent

3 *Bronze Bushings.* For Bronze Bushing the recommended practice is S.A.E. No. 64, a strong phosphor bronze with excellent anti-friction qualities, and capable of sustaining heavy loads and severe usage. The composition is as follows:

Copper....................78.5 to 81.5 per cent
Tin....................... 9. to 11. per cent
Lead...................... 9. to 11. per cent
Phosphorus................ 0.05 to 0.25 per cent
Zinc, max.........................0.75 per cent
Other impurities, max..............0.25 per cent

Good castings of this alloy should give the following minimum physical characteristics:

Ultimate strength..........25,000 lb. per sq. in.
Yield point................12,000 lb. per sq. in.
Elongation in 2 in.................. 8 per cent

MECHANICAL ENGINEERING

A Monthly Journal Containing a Review of Progress and Attainments in Mechanical Engineering and Related Fields, The Engineering Index (of current engineering literature), together with a Summary of the Activities, Papers and Proceedings of

The American Society of Mechanical Engineers

29 West 39th Street, New York

Problems Encountered in the Design of High-Pressure Machinery

THE term "high-pressure" is merely a relative one, and as manufacturing processes progress and the methods of handling become more familiar, undoubtedly pressures will increase and the word "high" in this connection become less significant. Two generations ago one hundred pounds steam pressure was relatively high, but as soon as designers and users mastered the problems of higher pressures, the pressures of that day became insignificant.

No doubt as design of apparatus to produce pressure, material, and methods for handling pressure improve, we shall see higher pressures. The present generation of engineers have seen pressures of a thousand pounds, which early in their experience seemed high, placed in the obsolete class, and pressures of two to four thousand pounds are beginning to lose importance on account of improved designs and familiarity with handling.

Pressures of fifteen thousand pounds are now produced and used, but it should not be inferred that any pressure near that amount will become general, for it could not be applied except in special instances; but with the design of apparatus to produce this pressure successfully and the selection of material to handle it safely, many of the pressures now used will lose their designation as "high."

The pressures and problems referred to are some of those encountered in compressing gases for manufacturing and industrial purposes, and in speaking of gases the term is used broadly and intended to include air, oxygen, hydrogen, acetylene, carbonic acid gas, nitrous oxide, ammonia, sulphur dioxide, helium and mixtures of gases.

There are, however, pressures which are still high and which present complex problems to both designer and user, problems in which the character of the gas figures most prominently in designing pressure-producing apparatus and at present controls the pressures within certain limits. In some cases excessive pressures accompanied by sufficient changes in temperature will alter the condition of the gas. The ultimate use of the gas often controls the pressure and design.

In some instances the pressure must be produced without an appreciable increase in temperature, in others the temperature does not figure so prominently, while in still others increases in temperature are necessary during the production of pressure.

The gas itself is a determining factor, for even before design in regard to volumes and pressure, in many instances materials must be considered. Materials which can be used when handling one gas with perfect safety may in the presence of another gas and even at a lower pressure form an extremely explosive compound. Metals that serve satisfactorily in the handling of heavy and dense gases may not be sufficiently close-grained to handle light gases. Sometimes metals cannot be used at all. Where neither of two gases will corrode ordinary materials, sometimes their mixture in certain proportions, even though it is physical and not chemical, will in a comparatively short time ruin anything except special materials.

New combinations of gases are appearing and old combinations which heretofore have not been generally employed have been made available for new uses through the proper design of high-pressure machinery and materials.

The power problem enters prominently, for some gases, like some materials, are very much heavier than others, the heavier gases requiring more power than the light ones, all other conditions being equal.

The leakage of gas during compression and handling also influences the kind of power selected and its application. Some gases when mixed with air will make an explosive mixture and engine-room conditions then become dangerous. Leakage is also dependent to some extent on the lightness of the gas. A light gas will leak faster than a heavy one, and precautions in design must be taken as this leakage might prove a financial loss for certain gases are quite costly.

Lubrication of the compressor is very important, not only in amount but as regards quality and place of injection. In some instances too much lubricant or poor quality causes trouble in the compressor or pipe line. One gas requires a lubricant with water at its base, for if oil were used it would explode. With another gas, which ordinarily would not be affected by oil, a water lubricant must be used on account of the use of the gas after compression. There are gases where no lubricant is required, the gas itself containing sufficient lubricant, while other gases absorb some kinds of lubricant and their subsequent efficiency is impaired. A lubricant may combine with a gas during compression and entirely change the gas. In still another case the ultimate use of the gas determines the lubricant, for ordinary oil would make the gas unfit for use.

After considering the gas, its physical and chemical properties, and the pressures to which it can be safely compressed, the volume to be handled in individual units must be determined. There may be gases which can be handled to high pressures safely in comparatively small volumes, which in large volumes might cause trouble.

The purity of gas entering the compressor is important. Certain gases if pure are safe to compress, but if polluted with other gases may not be dangerous at atmospheric pressure but will explode when compressed. Two gases which when combined in a certain way form part of our bodies and food, when combined in another way will burn steel, and in still another way, though harmless, at atmospheric pressure and temperature, cannot be compressed together without a frightful explosion resulting.

The pressure of the gas at the intake of the compressor is extremely important, for this very materially influences the design of the compressor and is also an important item in determining the power required. Atmospheric pressures varying according to altitude change the design of a compressor often very radically, especially if the final pressure is high.

The particular use of the gas under pressure, whether it is to be used at a constant pressure through comparatively wide limits, or whether the pressure is to be built up from the intake to a certain definite pressure, materially influences the design. Certain features of design are affected if the compressor is to stop and start again during the building up of pressure in the line, particularly if no gas is to be lost. Varying capacities but at constant pressure and varying pressures with varying capacities also require special attention. The nature of the power available or most convenient sometimes changes the whole design. Location of compressor and transportation facilities have been known to control design.

The foregoing are by no means all of the problems existing, and no doubt as new uses for gases are devised new problems will present themselves. EBENEZER HILL.

The South—A Field for Great Engineering Development

IN Mr. Adsit's paper on Power Development in the Southeast, printed in this issue of MECHANICAL ENGINEERING, the author takes occasion to emphasize the dependability of the water power of the South. He further states that the resources are available for ample provision of power for the growing industries of that section. In another paper in this issue Mr. F. H. Neely treats of the desirable characteristics of southern labor.

These two statements regarding fundamentals for sound industrial development have led us to look farther into the present status of the South in industry and to ascertain something of its natural resources. Space does not permit a tabulation of facts, but a few statements that show trends will undoubtedly be of interest.

In 1920, nearly one-sixth of the manufactures of the country were produced in the South. In the same year nearly one-half of the active cotton spindles and three sevenths of the active cotton looms were in southern mills and five-eighths of the cotton used in the country was processed in these mills. One-ninth of the country's pig iron and one-half of the lumber came from the South.

We find that all of the bauxite, turpentine and resin of the country is in the limits of the southern states. They also have 60 per cent of the natural gas, 50 per cent of the lumber, 45 per cent of the lead, 42 per cent of the zinc, 30 per cent of the lime, 26 per cent of the coal and 10 per cent of the iron ore.

Furthermore, and contrary to general understanding, there is a large section of the South at an elevation of about 1000 ft. above sea level with a pleasant climate and reasonably constant temperature.

All of the foregoing point to an industrial future for the South which is of great interest to the entire country, for the prosperity and industrial activity of a country must be well distributed to insure the prosperity of the nation. This industrial future must be of even greater import to the engineering profession and especially to the mechanical engineer, the "engineer of industry."

The holding of the Spring Meeting of The American Society of Mechanical Engineers in Atlanta this year will therefore be of great value, not only in stimulating engineering interest in the South but in setting up a contact between southern engineers and those of the rest of the country.

Recognition of Independent Status of the British Royal Air Force

AS the result of a discussion on March 16, 1922, in the House of Commons, the status of the Royal Air Force with respect to the other branches of the British War Establishment has been defined. According to a statement by Mr. Austen Chamberlain as leader of the House, the Government has arrived at the following conclusions:

First, That the Air Force must be autonomous in matters of administration and education.

Second, That in the case of defense against air raids the Army and Navy must play a secondary role.

Third, That in the case of military operations by land or naval operations by sea, the Air Force must be in strict subordination to the general or admiral in supreme command.

Fourth, That in other cases, such as protection of commerce and attacks on enemy harbors and inland towns, the relations between the Air Force and the other Services shall be regarded rather as a matter of coöperation than of the strict subordination which is necessary when airplanes are acting merely as auxiliaries to other arms.

Lastly, the Government has decided to appoint a committee to examine carefully into the system of naval and air coöperation and to advise how best to insure that the Air Force be enabled to render to the Navy, and also to the other Services, the aid that they may require.

For Great Britain this means definitely that the Royal Air Force becomes henceforth the first line of defense, for obviously the only possible means of attack on the British Isles is by air.

The decision of the Government in this connection is in many respects revolutionary, as it subordinates old-established and immensely wealthy services to what is practically a newcomer in the field. Its importance, however, should not be exaggerated, because while the Royal Air Force has been given such prominent tasks to perform, its whole budget barely equals the cost of two capital ships under present conditions.

Alfred Noble Memorial Tablet Unveiled

Impressive addresses marked the unveiling of the Alfred Noble Memorial Tablet in the Engineering Societies Building, New York City, on the afternoon of Wednesday, March 15. The tablet was presented by the American Institute of Consulting Engineers. The American Society of Mechanical Engineers together with the other national engineering societies joined in the tribute to Mr. Noble who had held office in the A.S.M.E. and several of the professional societies, and was a recipient of the John Fritz Medal awarded for achievement in engineering work.

ALFRED NOBLE MEMORIAL TABLET

The ceremonies took place in the entrance hall of the Engineering Societies Building, where the tablet has been placed. Charles Wellford Leavitt, chairman of the Alfred Noble Memorial Committee, delivered the principal address; Dr. Alexander C. Humphreys, president of the American Institute of Consulting Engineers, presented the custody of the tablet to the United Engineering Society, and J. Vipond Davies accepted the tablet, the work of Willard Paddock, on behalf of the Board of Trustees of the United Engineering Society.

Mr. Noble became a member of The American Society of Mechanical Engineers in 1907. From 1912 to 1916 he was one of the managers of the Society, and for the year 1913–1914 he was a member of the Executive Committee of the Society's Council.

The tablet contains this inscription:

"Alfred Noble, 1844–1914. An Upright Man, A Good Citizen, An Eminent Engineer, Whose Life and Labors Contributed Greatly to the High Honor of His Profession and to the Success of Many Important Public Works."

The more important of Mr. Noble's public services are outlined

on the tablet which lists his work from 1904 to 1909 as engineer of the Pennsylvania Tunnels, East River Division, and his services in 1895 with the Nicaragua Canal Commission. Other feats of Mr. Noble's included are his work from 1897–1899 with the U. S. Board of Deep Water Ways; 1872–1882 as engineer of the construction locks at St. Ste. Marie; 1909–1914, consulting engineer of the Catskill aqueduct; Pearl Harbor dry dock in Hawaii; 1899 to 1902, Isthmian Canal Commission; and as resident engineer on the Washington, Memphis and Cairo bridges from 1872 to 1882 He served in the Iron Brigade as a United States soldier from 1861 to 1865.

Edwin Allen Fessenden Accepts Professorship at Rensselaer Polytechnic Institute

Announcement has been made by the Rensselaer Polytechnic Institute that Prof. Edwin A. Fessenden of Pennsylvania State College will become, at the beginning of the next collegiate year, professor and head of its department of mechanical engineering.

Professor Fessenden was born 40 years ago in Butler County, Ohio, but spent his boyhood in St. Louis, Mo. where he attended the St. Louis Manual Training School. Later he entered Washington University and then the University of Missouri, securing at the latter institution the degree of bachelor of science in mechanical engineering in 1906 and two years following, the degree of mechanical engineer. From 1905 to 1907 he was an instructor in mechanical engineering in the University of Missouri and for the next nine years served there as assistant professor and associate professor of mechanical engineering. For one and a half years of this latter period he was in charge of the department of mechanical engineering and also served for a similar period as Acting Dean of the School of Engineering and Director of the Engineering Experiment Station.

From 1916 to the present he has been professor of mechanical engineering and head of the department at Pennsylvania State College and during the last two years has designed and constructed a new mechanical-engineering laboratory for this institution.

His research work at the University of Missouri Engineering Experiment Station included the study of coal weathering and heat transfer in boilers, while he has been the author of various articles in engineering journals, papers and discussions in the proceedings of the A.S.M.E., American Society of Refrigerating Engineers, and Society for the Promotion of Engineering Education, as well as bulletins of the Engineering Experiment Station of the University of Missouri.

Professor Fessenden was elected to full membership in the Society in 1914. He is also a member of the Society for the Promotion of Engineering Education, Sigma Xi, Tau Beta Pi, Sigma Tau and Alpha Tau Omega. He will undertake his new duties in the Fall when the present incumbent of the position, Dr. A. M. Greene, Jr., becomes Dean of Engineering at Princeton University.

Tufts College Giving Lectures by Radio

Probably the first instance of an American college giving instruction by radio is the course of fifteen lectures prepared by the faculty of Tufts College and being broadcasted by the American Radio & Research Corp. from its station at Medford Hill, Mass., twice a week beginning April 6 and concluding May 27.

By tuning the wireless telephone receiving instrument to 360 meter wave length and listening for signal WGI, these lectures, which cover a variety of topics, can be heard any Monday or Saturday evening.

The Word "Symposium" Misused

To the Editor:

I notice that your Society uses the word "symposium" very frequently to indicate a series of meetings to discuss some particular section of our activities, but I think that, if you looked up the meaning of the word, you will agree with me that it is hardly suitable for a "—— country."

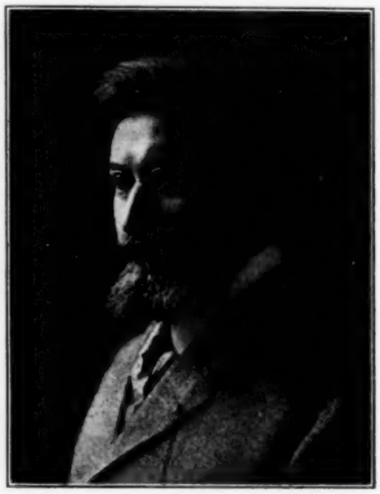
Daniel Adamson.

Hyde, Cheshire, England.

Henry Hess, Former A.S.M.E. Officer, Dies

Mr. Henry Hess, Past Vice-President of The American Society of Mechanical Engineers, died at his home in Atlantic City on March 23, 1922. He had been in failing health for the past two years but had been so much improved that he had visited his office in Philadelphia several days before his death.

Henry Hess was born in Darmstädt, Germany, in March, 1864, and came to the United States when a small boy. His education was received in the New York schools, and was supplemented by several years of additional schooling in Germany. After his return to the United States he was employed at the Watervliet Arsenal, Troy, N. Y., and later at the Niles Tool Works, Hamilton, Ohio. While in the employ of the latter concern he was sent to Germany to erect the German Niles Tool Works at Oberschoeneweide, near Berlin. He remained to have charge of the operation of this plant for two years after its erection. Upon his return to the United States in 1902 he organized the Hess-Bright Manufacturing Co. In 1912 he sold his interests in this company and organized the Hess Steel Corporation of Baltimore, with which organization he was connected at the time of his death.



Henry Hess

Mr. Hess became a member of The American Society of Mechanical Engineers in 1906. From 1911 to 1914 he served the Society as Manager, and from 1914 to 1916 as Vice-President. In 1915 he presented to the Society a gift of $2000, the income from which is given annually as the Junior and Student Prizes for the best technical papers by Junior and Student Members. Mr. Hess was past-president of both the Society of Automotive Engineers and of the Philadelphia Engineers' Club; he was a member of the American Institute of Mining Engineers, the American Society for Testing Materials, the American Iron and Steel Institute, the American Electrochemical Society, the American Academy of Political and Social Science, The Franklin Institute, the New York Engineers' Club, the Art Club of Philadelphia and the Economics Club.

During his lifetime Mr. Hess was a contributor to various technical publications. He was a special lecturer at Columbia University on subjects on which he was an authority. Of late years he had been greatly interested in color photography and had lectured on this subject before various organizations.

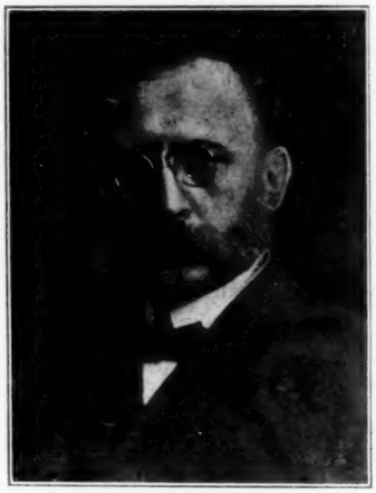
Mr. Hess is survived by his wife, two daughters and a son, Mr. H. Lawrence Hess of Philadelphia, a member of the Society.

Industrial Teachers' Scholarships for New Yorkers

Within the near future the University of the State of New York will award twenty-five scholarships to qualified trade and technically trained men who desire to prepare themselves for teaching. Each person selected for a scholarship will receive at least $1000 for one school, year period and be required to attend for ten months the Industrial Teacher Training Department of the State Normal School at Buffalo. Upon satisfactory completion of this training course the scholarship holder will be licensed for life to teach his specific occupation in the vocational schools of the state, and under the present schedule will be paid a salary ranging from $1800 to $3500 per annum. The Director of Vocational and Extension Education, State Department of Education, Albany, N. Y. will furnish detailed information and application blanks upon request.

William Newton Best Dies

William Newton Best, one of the very well-known members of the Society in the field of liquid-fuel burning, died in Brooklyn on April 11, 1922. Mr. Best was born at Clayton, near Quincy, Illinois, on June 3, 1860, and attended the public schools there and the Gem City Business College. He then went into railroad work and continued in various capacities until 1901, when he resigned his position as superintendent on the Los Angeles and Salt Lake Railroad to begin the manufacture of his own inventions. At the time of his death he had U. S. letters patent covering forty-four devices, most of them relatting to the oil-burning industry, and was president and consulting engineer of the W. N. Best Furnace and Burner Corporation at 11 Broadway, New York.



William Newton Best

Dr. Best was the author of the book Science of Burning Liquid Fuel, and in 1917 the honorary degree of Doctor of Science was conferred on him by the Lincoln Memorial University, Cumberland Gap, Tenn., of which he was for some time a member of the Board of Trustees.

He became a member of the A.S.M.E. in 1912; he was one of the committee appointed in 1918 to revise its Boiler Test Code, and served for some time as its representative on the Board of the Engineering Societies Library. He was also a Fellow of the Royal Society of Arts, London, and a member of the American Institute of Mining and Metallurgical Engineers, the American Institute of Metals, the International Railway Fuel Association, American Railway Master Mechanic's Association, The Franklin Institute, the Aero Society of America and of the New York Academy of Sciences.

He was also a member of the Long Island Lodge 382 F. and A. M., vice-president of the Board of Directors of the Goodwill Industries of Brooklyn, Inc., vice-president of the Board of the Williamsburgh Rescue Mission, Inc., and a member of the Board of Governors of the Neponsit Club of Long Island.

Dr. Best will be missed by a host of friends, as well as in the many activities in which he was interested.

Meeting of the Taylor Society

One of the best-balanced and most successful meetings that the Taylor Society has ever held took place at the City Club, Philadelphia, March 16 to 18. The City Club and the Engineers' Club of Philadelphia extended guest privileges to both members and guests and approximately 450 were in attendance.

At the opening session on Thursday morning Dr. H. S. Person, Managing Director of the Society, presided and John M. Holcombe, Jr., manager Sales Research Division, Phoenix Mutual Life Insurance Company, Hartford, Conn., read a paper entitled A Case of Sales Research. Studies in territory analysis, the selection of salesmen, rating scales, personal-history blanks, and in general somewhat the same system of investigation used for classifying their risks was outlined as applied to the sales force.

In the afternoon, with Richard A. Feiss, President of the Society, in the chair, The Problem of the Chief Executive was presented by Henry P. Kendall, of Boston. Mr. Kendall's position as one of our younger captains of industry who has developed scientific management in one plant after another in accordance with a consistent policy for a number of years, lent additional interest to his paper. On Friday Mrs. L. M. Gilbreth, due to Mr. Gilbreth's absence abroad, read a paper on Super-Standards which won much approval. The general use of the title word was deplored as limiting, since the super-standard of today is the standard of tomorrow. At the afternoon session George E. Frazer of Frazer and Torbet, Chicago, read a paper on Budget Control in which the necessity in industry for coöperation on financial considerations throughout the departments was emphasized.

The current series of articles in the *Atlantic Monthly* by Arthur Pound attracted particular attention to his address, which he entitled Mills and Minds. His statement that the industrial problem of today is that of labor rather than material and that the principles of psychology should be applied to industrial management, was most favorably received.

The closing session was devoted to two papers in the field of operating technique. The first, by Percy S. Brown, works manager of the Corona Typewriter Company, was called String-Board Graphics, and described an effective method of this type of control at his plant. The second, The Work of the Balance-of-Materials Clerk, by Thomas W. Mitchell, management engineer, Philadelphia, described the standard Taylor method in the particular field considered, and was the first of a series which he is preparing on standard Taylor practice.

Power Show to Follow 1922 Annual Meeting

The tentative program for the 1922 A.S.M.E. Annual Meeting calls for a Session of the Fuels Division on Wednesday, December 6, and a session of the Power Division on Thursday morning December 7. At noon on Thursday the Exposition of Power and Mechanical Engineering will be opened in the Grand Central Palace. This exposition will include apparatus employed in the generation, distribution and use of power. The managers of the show have had considerable experience in the conduct of various chemical, flower and automobile shows, in which they have been successful in developing large, highly educational exhibitions of proven value to technicians and industries.

An advisory committee has been appointed to assist in determining the policies of the exposition. This committee includes the names of the presidents of The American Society of Mechanical Engineers, The National Electric Light Association, and the National Association of Stationary Engineers.

"Luminaire"—a Good Substitute for a Bad Combination

The coming into vogue of appliances which can be removed from place to place and to which the misnomer "movable fixtures" has been attached has brought the matter particularly to the attention of the lighting people. The Illuminating Engineering Society referred the consideration of this question to its Committee on Nomenclature and Standards with the suggestion that a term be recommended. Requests for suggestions of suitable terms were sent out to the membership of the Society and a considerable number of such suggestions were received. It was found, however, that most of the terms proposed were manufactured or coined words which had no legitimate ancestry and were therefore objectionable. Among the terms suggested, however, was one which met with the approval of the Committee; namely, the word "luminaire." This word is used in this connection in the French language. Its construction and ancestry are such that it can be adopted into the English language as readily as "garage," "hangar," etc., which have recently been taken in. The significance of the word is evident on the face of it. It is believed that this word could and should be introduced into the English language and that it would be a distinct advantage so to do.

The Committee on Nomenclature and Standards recommended the use of this generic term for "lighting unit" in its report as presented to the annual convention of the Society at Rochester last September.

The Council of the Illuminating Engineering Society at the March meeting formally approved and adopted the use of the word "luminaire."

An expression of opinion favorable to the adoption of this term has been received from Engineering Societies and other organizations.

Engineering and Industrial Standardization

Agreement Near on Machine-Screw-Thread Standardization in This Country

FOR the past eight months the Sectional Committee on the Standardization and Unification of Screw Threads, Luther D. Burlingame, Chairman, has been making a careful review of the Progress Report of the National Screw Thread Commission published in the Spring of 1921. The Working Sub-Committee of seven, to which the detailed study was assigned, reported its findings to the Section Committee on March 15. This report is in the form of a working manual on the American machine-screw thread and is based entirely on the N.S.T.C. Report. It omits, however, all reference to the loose fit, pipe thread, methods of gaging, and fire-hose couplings, all of which are treated by the Commission.

The Sectional Committee examined this manual very thoroughly, and after making numerous suggestions referred it for final revision to a special committee consisting of Messrs. Elwood Burdsall, Ralph E. Flanders, and Earle Buckingham. The Sectional Committee also instructed Messrs. Wells, Ehrman, Flanders, and Buckingham, who are members of the N.S.T.C. as well as members of the Sectional Committee, to confer informally with the Commission on certain points. This was done on March 17 in Washington at a regularly called meeting. The results of this informal conference were very satisfactory to all concerned. Within a very short time, therefore, American screw-thread practice will be completely unified on paper at least, and a working manual will be ready for printing and distribution. All those interested in securing copies of this manual are requested to communicate with the Secretary to the Committee, C. B. LePage, 29 West 39th Street, New York.

Building Construction and Standardization

It has been estimated that the suspension of building during the war has produced a national shortage of dwelling houses of close on to a million, and due to high costs post-war building operations have been too limited to bring about any material change in the situation.

Herbert Hoover, Secretary of the Department of Commerce, has given this problem some attention during the past few months and is devoting the resources of his department to its solution. It is his opinion, however, that on each community rests the responsibility of solving its housing problem. He holds that we are, or should be, a country of local community action and that the province of the Federal Government is to stimulate and assist local action.

Each local community must in a large measure solve its housing problem since the three principal factors entering into it have, at present at least, large local significance. Cost of materials, cost of labor, and available home-building capital are of necessity different in the various localities. If the local community develops its own resources in each of these items, high railroad rates need not be considered.

In this activity the Department of Commerce is working through a broadly representative central Building Code Committee with Dr. Ira H. Woolson as its chairman. Its first effort was to bring about local conferences on the housing situation in the different cities with a view to ameliorating conditions. These conferences have been held in over one hundred cities with the coöperation of many unofficial bodies. The latter comprised chambers of commerce, labor organizations, building and other trade associations, bankers, material manufacturers, and contractors. Through these conferences and through other forms of local initiative a very considerable amount of good has been accomplished, although the results have varied a great deal between cities. Positive plans have been worked out in many of them and great stimulation to home building has ensued. Where they have gone upon the rocks it has been due to corrupt conditions of the building trades or to wage questions.

The Building Code Committee has, in addition to its local effort, created a number of agencies for the purpose of securing constructive solution to some of the more general problems. Various special committees have been formed and are engaged in sincere efforts in the following fields: Standardization of Contractor's Specifications; Simplification of Plumbing Requirements and Practice; Standardization of Clay Products, Lighting Fixtures, Lumber, Paint and Varnish and Standardization of the elements in House Design. These efforts at standardization and simplification are directed against the high cost of material; it is hoped, however, that they will also have their effect in reducing the labor cost of buildings.

The Committee on Plumbing Specifications is making good progress and is directing a considerable amount of experimental work which is being carried on at the Bureau of Standards. It, as well as the general committee, is also in close touch with the American Engineering Standards Committee, through which they receive the support and assistance of its member-bodies.

Bolt, Nut and Rivet Proportions

On Thursday, March 16, the Sectional Committee on Bolt, Nut and Rivet Proportions held its organization meeting in New York. Though the personnel of this Sectional Committee is not yet complete, 23 of its members attended this meeting. The manufacturers were represented by 12, the Consumers by 9, and the General Interests by 2. The Consumers' group consisted of representatives of nine societies and associations.

After attending to certain organization matters the scope of the committee's work was informally but very fully discussed. As a result of which, it was decided to divide the field into seven more or less distinct parts. Through the medium of a special Committee on Committees the personnel of the corresponding seven sub-committees was tentatively determined and, in the afternoon following the meeting of the Sectional Committee, four of these Sub-Committees organized and made plans for the preliminary collection of data and information. The names of the seven Sub-Committees with their officers are given below.

1 *Sub-Committee on Large and Small Rivets*
  G. W. Nelson, *Chairman*
  F. W. Fritchey, *Secretary.*
2 *Sub-Committee on Wrench Heads and Nuts*
  G. F. Jenks, *Chairman* and *Secretary.*
3 *Sub-Committee on Slotted Heads*
  E. Winsor Reed, *Chairman*
  E. M. Whiting, *Secretary.*
4 *Sub-Committee on Track Bolts*
5 *Sub-Committee on Carriage Bolts*
6 *Sub-Committee on Special Bolts and Nuts for Agricultural Machinery*
  E. P. Stahl, *Chairman.*
7 *Sub-Committee on Body Dimensions and Material*
  S. F. Newman, *Chairman.*

Code for Electricity Meters

The National Electric Light Association and the Association of Edison Illuminating Companies have submitted to the American Engineering Standards Committee for approval as American Standard the Code for Electricity Meters, known as the "Meter Code."

Nine of the ten sections of the present code were prepared in 1912 by a joint committee of the two associations and representatives from the Electrical Testing Laboratories, from the leading meter-manufacturing companies and from public-service commissions and other regulatory bodies organized for the purpose of supervising electric service.

The code contains a tenth section, Parts A, B, and C of which were brought out in 1916 and Parts D and E in 1920. The organizations presenting the code for approval state that it represents in crystallized form standard American meter practice as nearly as it has been possible to determine it by impartial consideration and criticism.

The American Engineering Standards Committee would be very glad to learn from those interested of the extent to which they make use of this Standard and this Code. It desires also to receive any other information regarding the code in meeting the needs of the industry.

LIBRARY NOTES AND BOOK REVIEWS

Library in Need of Proceedings

The Engineering Societies Library requires the Proceedings of the American Railway Engineering Association for 1918, 1919 and 1920 to complete its file, but due to the fact that these issues are out of print it has been unsuccessful in securing them through the regular channels.

Any member of the Society having these copies and presenting them to the Library, would be coöperating in the proper preservation of engineering records for reference use and the benefit of the profession.

Work of Recataloging Engineering Library Steadily Progressing

Members of the Society will be interested to learn that the work of recataloging the vast number of volumes composing the Engineering Societies Library is progressing so well that to date about 65 per cent has been completed. This means that since the task was started in July, 1919, 52,111 volumes, representing 14,745 titles, have been cataloged; 33,513 subjects have been made available and author entries for all books have been added to the catalog while 103,809 cards have been filed.

The great care and accuracy required in compiling a catalog of books is beyond the comprehension of most persons unfamiliar with such work. A catalog is not merely a list of books. Unless it discloses the purpose of each book and reveals its contents in such a way as to inform the research worker, it is not presenting the resources of the library. It must be made with both the reader and the book in mind and should be so suggestive as to lead the man to all available references. The catalog cannot be an exhaustive index but rather it is a sign board to point the way to detailed material which the reader can follow up and exhaust for himself. The proposed catalog of the Engineering Societies Library, through its detailed subject index, will reveal much more specific references than would be possible in any other type of catalog.

In the preparation of the catalog, the books must first be classified and book classification is a science. Under the subject of railroads, for example, it is not enough to know that there are books on locomotives, terminal stations, signals, road beds, rolling stock, etc., but the classifier must first realize that the two main divisions of this subject are the engineering or construction and the transportation and economy, and that the literature on the subject will naturally fall into one of these groups. By the use of classification charts the limitations of groups are clearly defined, important points that it is necessary to keep in mind when analyzing the books are determined, and a sensible general guide established.

The next step is to decide the correct subject of each book, not simply by the title page, but through a careful perusal of the text. One book can stand in only one place on the shelves, but the same book can appear in any number of places in the catalog, and the great advantage of a catalog which gives an analysis of a book from all angles must be developed to the highest degree.

Then follows indexing under authors and perhaps contributing editors, and finally the assignment of a symbol by which it can be identified. A record of these symbols is kept, together with the author and title they represent, and it serves as an inventory of the books as they stand on the shelves.

The whole undertaking requires the most careful and painstaking work, with each book being handled from fifteen to twenty times after its receipt from the publishers until it is placed on the shelves. However, the results justify the time, labor and funds expended. With less than three-quarters of the books completely analyzed, it has been found that the efficiency of the library has increased in amazing proportions, as is apparent to the members of the library staff who daily answer many inquiries covering a great variety of subjects.

Book Notes

Aggregation and Flow of Solids. By Sir George Beilby. Macmillan and Co., Ltd., London, 1921. Cloth, 6×9 in., 256 pp., illustrated with plates, 20s.

The molecular structure and physical properties of matter in the solid state have engaged the author's attention for many years, and from time to time papers embodying the results from particular researches have been published. The entire series of investigations has now been collected and sifted, and the results appear in the present volumes as a consecutive whole. The book is an interesting record of actual experimental observations, many of which have important industrial applications, and a summary of the conclusions reached by the author as to the meaning of the phenomena observed. A large number of excellent photomicrographs are included.

Blue Printing and Modern Plan Copying. By B. J. Hall. Sir Isaac Pitman & Sons, Ltd., New York, 1921. Cloth, 5 × 8 in., 130 pp., illus., $2.

Of interest to engineers who have plans to be copied, to installers of copying plants and to operators. The first section of the book discusses the capabilities of contact photography and allied processes for copying drawings, as well as the proper preparation of drawings for reproduction. Section two describes the machinery and apparatus used in blueprinting plants. The concluding section deals with the layout of blueprinting rooms and methods of working. The treatment includes both contact and camera processes.

Cotton Facts. Compiled and edited by Alfred B. Shepperson. Revised and enlarged by C. W. Shepperson. Shepperson Publishing Co., New York, 1921. Cloth, 4 × 7 in., 180 pp., portraits, map.

A convenient compilation of commercial and financial information required by those engaged in the cotton industry, which has appeared annually for forty-six years.

Descriptive Geometry. By George Young and H. E. Baxter. The Macmillan Co., New York, 1921. Cloth, 5 × 8 in., 310 pp., diagrams, $3.25.

Believing that the chief value of descriptive geometry lies in its imaginative quality, these authors present it so as to develop the imagination; and therefore they encourage intuitive rather than rigidly formal methods. The treatment has been kept purely abstract, in order to avoid the tendency of the subject to degenerate into practical rules and formulas; introductory matter showing the relation of the principles under discussion to structural work is provided, and exercises to show the application of the abstract ideas to concrete, practical problems are included.

Distribution of Gas. By Walter Hole. Fourth edition. Benn Brothers, Ltd., London, 1921. Cloth, 7×10 in., 699 pp., illustrated with diagrams, 50s.

This book is uniform in size with Mead's Modern Gasworks Practice, to which it forms a fitting companion. That work treats of gas manufacture; this takes up the account at the gas holder and discusses the distribution to the consumers' appliances. The scope of the volume is a wide one. The opening chapter discusses the rights and duties of gas undertakings. Succeeding chapters treat of discharges from pipes, station governors, districting, pipes and joints of iron and steel, mainlaying, valves and cocks, conduits, service pipes, meters, internal fitting, internal lighting, gas stoves and heaters, gas engines, industrial uses of gas, pressures, complaints and repairs, street lighting, high-pressure distribution, high-pressure lighting and heating, leakage, electrolysis and fusion. The information given is thoroughly representative of current practice. All obsolete matter has been deleted in preparing this new edition and much that is new in connection with this work has been added.

Dynamic and Static Balancing. By Edward K. Hammond. First edition. Industrial Press, New York, 1921. Paper, 6×8 in., 58 pp., illus., $0.50.

A discussion of the principles of balancing, with a description of machines and methods, written in simple language. Intended for shopmen. Avoids mathematical theory.

Die Eisenkonstruktionen. By L. Geusen. Third edition, revised. Julius Springer, Berlin, 1921. Cloth, 8×11 in., 282 pp., diagrams, tables, 384 marks.

This textbook for students of structural engineering is divided into three sections, treating respectively of the principles, of steel buildings, and of bridges. By this arrangement the general rules and methods governing steel structures are taught first and emphasized by suitable problems, taken from practice. The application of these methods in framing buildings and bridges is considered in the later sections. The text is concise and illustrated by numerous drawings. An appendix contains the necessary tables of the properties of structural shapes.

Die Wasserversorgung der Staedte. By O. Smreker. Fifth edition. Wilhelm Engelmann, Leipsig, 1914. Cloth, 7×10 in., 522 pp., illus., diagrams, tables, 57 Marks.

This work forms the third of the twelve volumes upon hydraulic engineering which constitute the third section of the Handbuch der Ingenieurwissenschaften, and is concerned with municipal water supplies. The present edition has been thoroughly revised, both with respect to arrangement and contents. The arrangement follows the course of operations used in securing a water supply, discussing first the preliminary studies of the amount, quality and occurrence of the available sources, then the design of the plant in general. Succeeding chapters discuss the winning and purification of water, pumping and conveying, and the operation of waterworks. Attention is directed toward general principles, rather than to the details of specific installations.

Electric Arc Welding. By E. Wanamaker and H. R. Pennington. Simmons-Boardman Publishing Co., New York, 1921. Cloth, 6×9 in., 254 pp., illus., $4.

This manual is based largely on a series of articles published in the *Railway Electrical Engineer*. It contains a large amount of practical information on many phases of the subject; descriptions of systems and their installation, phenomena of metallic and carbon welding arcs, training of welders, sequence of metal deposition for various types of joints and building-up operations, electrodes, thermal disturbances due to welding, properties of welds, efficiency of equipments and costs. The book is confined to autogenous arc welding.

Electric Ship Propulsion. By S. M. Robinson. Simmons-Boardman Publishing Co., New York, 1922. Cloth, 6×9 in., 274 pp., illus., diagrams, $6.

This volume treats of the special questions relating to steam turbines, electric generators, induction motors and other machines, which arise in connection with the propulsion of ships by electricity, and compares this method with others. The various systems are explained and compared. The installations on several ships of the Navy and on the *Wulsty Castle*, which illustrate the application of various systems, are described in detail.

Elements of the Differential and Integral Calculus. By William S. Hall. Second edition, revised. D. Van Nostrand Co., New York, 1922. Cloth, 6×9 in., 250 pp., $2.75.

This textbook is an endeavor to present the calculus and some of its important applications simply and concisely, yet fully enough to make possible the study of subjects that call for knowledge of it. In this new edition chapters 1, 4 and 5 have been rewritten, other revisions have been made and many new problems added.

L'Ether Actuel et ses Precurseurs. By E. M. Lémeray. Gauthier-Villars et Cie, Paris, 1922. (Actualités scientifiques.) Paper, 5×7 in., 141 pp., 6 fr.

The author of this book, an early student of the investigations of Lorentz and Einstein, is a master of the theories of relativity and has written several summaries of them. In the present work he traces the development of the idea of the ether, which these theories tend to modify anew. The book is the result of an extensive examination of the history of science. Beginning with the ideas of the Chaldeans and Egyptians concerning a universal spirit, the modifications due to the Greeks and Romans, the ether of Huyghens, phlogiston, caloric, the ether of Fresnel and that of later students are described.

Factory Administration in Practice. By W. J. Hiscox. Sir Isaac Pitman & Sons, Ltd., New York, 1921. Cloth, 6×9 in., 214 pp., $2.50.

Most of the books on factory administration seem to have been written by accountants for accountants, our author thinks, and as a consequence have disregarded factory conditions to some extent. The present work is written from the factory viewpoint, and is intended for the works manager, the foreman and all members of the factory administrative staff. The views and schemes set forth are the results of sixteen years' practical experience with engineering firms in Great Britain. Special prominence is given to the progress system.

Giesserei-Handbuch. Herausgegeben vom Verein Deutscher Eisengiessereien Giessereiverband in Düsseldorf. R. Oldenbourg, München, 1922. Cloth, 7×10 in., 264 pp., tables, 300 M.

This handbook has been prepared by the German Iron Founders' Association as a convenient compendium of data used by foundry men. It includes the standards adopted by many European railroads, by associations and societies, methods for the analysis of cast iron, coal, coke, slags and flue gases, physical data for iron and other materials, the German standards for cast-iron pipe, tariff and statistical data concerning the trade, trade associations, and directors of German foundries and foundry-supply dealers.

Grundlagen der Flugtechnik. By H. G. Bader. B. G. Teubner, Leipzig, 1920. Paper, 6×9 in., 194 pp., $2.90.

A work for designers of airplanes, dealing with the calculations required and the proper methods and formulas. Covers all the calculations that are needed in practical design and illustrates their uses by application to the calculation of a concrete example. Contains a brief bibliography.

Heating and Ventilation. By John R. Allen and J. H. Walker. Second edition. McGraw-Hill Book Co., Inc., New York, 1922. Cloth, 6×9 in., 332 pp., illus., diagrams, tables, $3.50.

A textbook for use in engineering and architectural schools, intended also for use as a handbook by engineers and architects. A second edition has become desirable because of the advances in the art made recently, such as the establishment of standards for ventilation and the results obtained in the research laboratory of the American Society of Heating and Ventilating Engineers. The text has been thoroughly revised and enlarged to include recent developments.

Hydraulics of Pipe Lines. By W. F. Durand. D. Van Nostrand Co., New York, 1921. (Glasgow textbooks.) Cloth, 6×9 in., 271 pp., diagrams, $4.50.

Intended to give a discussion, in engineering form, of the more important hydraulic problems which arise in connection with pipe lines and pipe-line flow. No attempt is made to treat the subject structurally or descriptively. The successive chapters discuss general hydraulic principles, surge, water ram or shock, stresses in pipe lines, materials, construction, design, and oil pipe lines.

Jigs and Fixtures. By Albert A. Dowd and Frank W. Curtis. First edition. McGraw-Hill Book Co., Inc., New York, 1922. (Tool engineering.) Cloth, 6×9 in., 293 pp., diagrams, $2.50.

This book, the first of three upon the principles underlying the design of production tools, deals with the design of jigs and fixtures for drilling, indexing, milling, profiling, broaching, riveting, etc. A chapter is devoted to vises and vise fixtures. The work deals with principles, although many interesting fixtures are shown to

illustrate their use. The important points connected with the design and the relative desirability of various designs are discussed.

Modern Gasworks Practice. By Alwyne Meade. Second edition. Benn Brothers, Ltd., London, 1921. Cloth, 7×10 in., 815 pp., illus., diagrams, 55s.

The first edition of this book appeared in 1917 and quickly became out of print, through the immediate recognition of its worth as the most complete, authoritative account of modern practice extant. The new edition, while retaining all the merits of the first, has undergone an increase in bulk of 50 per cent through the addition of new matter, and has also been largely rewritten to take account of the upheaval in the technique of gas-works practice in England, caused by the substitution of a calorific standard for the former candlepower standard. Every phase of the works side of gas engineering is covered, from the planning and construction of gas works to the storage of the gas and recovery of the by-products. As a general work of reference, the book is of the greatest value to all engaged in the gas industry.

Operating Engineer's Catechism of Steam Engineering. By Michael H. Gornston. D. Van Nostrand Co., New York, 1922. Fabrikoid, 5 × 8 in., 428 pp., diagrams, $4.

An elementary textbook upon the construction and operation of boilers, steam engines and turbines, heating apparatus and pumping machinery, prepared for operating engineers. Covers the problems that confront the engineer with unusual fullness and is well indexed. Should be of assistance to those preparing for examination and as a pocket reference book.

Petroleum. By Sir Boverton Redwood. Fourth edition. J. B. Lippincott Co., Philadelphia, 1922. Cloth, 6 × 9 in., 3 vol., maps, plates, illus., tables. $21.

Sir Boverton Redwood's classic work is the product of a long professional career as a petroleum technologist, during which he acquired first hand knowledge of oil production, oil fields and oil men in all the important fields of the globe. He was, until his death, in touch with every source of information on petroleum. The material collected, after being critically sifted in the light of his broad experience, has resulted in a book that for twenty-five years has been recognized as an authoritative reference work. The present edition was in preparation when the author died, in 1919, and certain portions had received his final revision. The remaining portions have been revised by his friends, and the work has been seen through the press by A. W. Eastlake and Robert Redwood.

The general plan of previous editions is retained, although the entire work has been reset. Commencing with a historical account of the industry, the distribution, physical and chemical properties, and origin of petroleum are discussed in volume one. Volume two is devoted to production, refining, transportation, storage and distribution, and to the shale oil industry. Volume three treats of testing, uses, and laws; it also contains statistics, import duties and an extensive bibliography. This contains nearly nine thousand references; unfortunately, few, if any, are later than 1911.

Principles and Design of Foundation Air Brake Rigging. Air Brake Association, New York, 1921. Boards, 6×9 in., 121 pp., diagrams, $1.

In the interest of higher air-brake education, the Air Brake Association has secured from the Westinghouse Air Brake Company the right to publish this study of some of the finer points that contribute to the efficiency of air brakes. The book is the joint product of experienced engineers and should be useful to all users and designers of brakes.

Probenahme und Analyse Von Eisen und Stahl. By O. Bauer and E. Deiss. Zweite auflage. Julius Springer, Berlin, 1922. Cloth, 7×10 in., 304 pp., illus., 472 M.

This work presents methods for sampling and analyzing iron and steel adopted by the authors for their work at the National Testing Laboratory in Berlin. The first section, by Prof. Bauer, discusses sampling, emphasizes the importance of proper sampling and gives much information upon proper methods of taking, polishing and etching samples for microscopic examination. The metallographic characteristics of the constituents of iron and steel are described and directions given for securing representative samples of iron and steel for examination. The second section, by Prof. Deiss, gives reliable methods for the accurate chemical determination of the various constituents of iron and steel. This edition has been carefully revised and enlarged.

Questions and Answers Relating to Diesel, Semi-Diesel and Other Internal-Combustion Engines; Air Compressors, etc. By John Lamb. J. B. Lippincott Co., Philadelphia, 1922. Cloth, 4×5 in., 209 pp., $2.50.

A small pocket book of practical information for steam engineers and others preparing for license examinations.

Real Mathematics. By Ernest G. Beck. Henry Frowde and Hodder & Stoughton, London, 1922. (Oxford technical publications.) Cloth, 5×8 in., 306 pp., diagrams, 15s.

This book is intended to assist in the acquisition of a real, serviceable, sound mathematical equipment, by augmenting standard textbooks and orthodox methods of study. The author hopes it will contribute toward the adoption of a change of attitude toward mathematics by those who require it as a part of their working equipment, by showing it as an actual, tangible reality, instead of a collection of rigid and unrelated rules and formulas. The method given assists the student to visualize the various operations and processes used in mathematical calculation.

Textbook of Fire Assaying. By Edward E. Bugbee. John Wiley & Sons, Inc., New York, 1922. Cloth, 6 × 9 in., 254 pp., illus.

Based upon the course at the Massachusetts Institute of Technology and intended as a college textbook; but will also be useful, the author hopes, to more mature students. An endeavor has been made to give the scientific reasons underlying the phenomena that occur and the rationale of the processes and manipulations, and to avoid the character of a mere receipt book.

Theory of the Induction Coil. By E. Taylor-Jones. Sir Isaac Pitman & Sons, Ltd., London and New York, 1921. Cloth, 5×8 in., 217 pp., illus., $3.50.

Until recently there has been much divergence of view as to the manner in which the high potential is generated at the secondary terminals of an induction coil when the primary current is interrupted, and it cannot be said even now that opinion on the subject is quite undivided. In this book an account is given of a theory of the action of induction coils first put forward by the author in 1909. The theory was originally intended to apply only to the case of an air-core induction coil having a condenser connected with its secondary terminals. Subsequent investigations have shown that it is also applicable to an ordinary induction coil.

Valuation of American Timberlands. By K. W. Woodward. John Wiley & Sons, Inc., New York, 1921. Cloth, 6×9 in., 246 pp., maps, $3.

Gives the principal facts regarding the timber resources of the continental United States and its outlying territories, excepting Hawaii and the Canal Zone, in a form suited to the needs of investors, timber cruisers and students of forestry. Contains descriptions of the forest types of the country, and comparisons of their values.

Vervollkommnung der Kraftfahrzeugmotoren Durch Leichtmetallkolben. By Gabriel Becker. R. Oldenbourg, München, 1922. Paper, 7×11 in., 97 pp., illus., 75 M.

The first section of this work discusses the possibilities for improving automobile construction by reducing wind resistance and weight, increasing the size and efficiency of the engines, or by perfecting the engines thermodynamically and structurally. The second and longer section gives the results of an interesting series of tests upon light metal pistons, made in 1921 at the automobile testing laboratory of the Berlin Technical High School, under the direction of the author, with the assistance of the German Engine Manufacturers' Association. Extensive tests of 16 different aluminum- and magnesium-alloy pistons are presented and compared with tests of cast-iron and pure copper pistons.

THE ENGINEERING INDEX

(Registered United States, Great Britain and Canada.)

THE ENGINEERING INDEX presents each month, in conveniently classified form, items descriptive of the articles appearing in the current issues of the world's engineering and scientific press of particular interest to mechanical engineers. At the end of the year the monthly installments are combined along with items dealing with civil, electrical, mining and other branches of engineering, and published in book form, this annual volume having regularly appeared since 1906. In the preparation of the Index by the engineering staff of The American Society of Mechanical Engineers some 1200 technical publications received by the Engineering Societies Library (New York) are regularly reviewed, thus bringing the great resources of that library to the entire engineering profession.

Photoprint copies (white printing on a black background) of any of the articles listed in the Index may be obtained at a price of 25 cents a page. When ordering photoprints identify the article by quoting from the Index item: (1) Title of article; (2) Name of periodical in which it appeared; (3) Volume, number, and date of publication of periodical; (4) Page numbers. A remittance of 25 cents a page should accompany the order. Orders should be sent to the Engineering Societies Library, 29 West 39th Street, New York.

ABRASIVES

Properties and Uses. Grinding Wheels (Les Meules Artificielles), E. Assié. Arts et Métiers, vol. 74, no. 12, Sept. 1921, pp. 265–270, 7 figs. Discusses abrasives, carborundum, corundum, melting points, resistance to acid, use as refractories, etc.

ACCELEROMETERS

Auclair and Boyer-Guillon. Auclair and Boyer-Guillon Accelerometers (Les accéléromètres Auclair et Boyer-Guillon), A. Boyer-Guillon. Bul. de la Société d'Encouragement pour l'Industrie Nationale, vol. 133, no. 9, Nov. 1921, pp. 1167–1191, 19 figs. Describes weight, spring and triple-recording accelerometers, and their application in determining acceleration and periodical movements.

ACCIDENTS

Placing Responsibility. Placing Responsibility for Accidents, H. L. Keely. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 149–152, 3 figs. Through classifying according to kind and cause and by estimating cost of remedies.

ACCOUNTING

Pig-Iron Production. Accounting for Pig-Iron Production, Nathaniel B. Bergman. Jl. of Accountancy, vol. 33, no. 2, Feb. 1922, pp. 90–99. Discusses blast-furnace operations and how to deal with them in accountancy.

AERODYNAMICS

Resistance of Bodies. Influence of Model Surface and Air Flow Texture on Resistance of Aerodynamic Bodies, A. F. Zahm. Nat. Advisory Committee for Aeronautics. Report no. 139, 1922, 6 pp. Deals with resistance of smooth models in a smooth stream; resistance as a function of surface texture and of flow texture. More general resistance formulas.

Standardization. Standardization in Aerodynamics, W. Margoulis. Aerial Age, vol. 14, no. 26, Mar. 6, 1922, pp. 614–615. Agrees with article of same title by W. Knight, published in Aerial Age, June 20, 1921, as to standardization on basis of experiments of American, British, French and German quasi-official laboratories.

AERONAUTICS

Hydrodynamics, Application of. Applications of Modern Hydrodynamics to Aeronautics, L. Prandtl. Nat. Advisory Committee for Aeronautics, Report no. 116, 1921, 61 pp., 62 figs. Discusses the theoretical underlying principles, theory of aerofoils, and application of aerofoil theory to screw propellers.

AIR COMPRESSORS

Explosions. Explosions in Air Compressors, A. D. Risteen. Sugar, vol. 24, no. 2, Feb. 1922, pp. 99–100. Deals with presence of lubricating oil and carbon deposits, and suggests that all accumulation of deposits be prevented. From address before Nat. Safety Council.

AIR CONDITIONING

Air Drying. The Volume of Air Required in Air Drying, C. T. Mitchell. Chem. & Met. Eng., vol. 25, no. 24, Dec. 14, 1921, pp. 1088–1090, 3 figs. Factors affecting atmospheric evaporation; cooling of air during evaporation; distinction between wet bulb temperature and dew point; calculation of volume of air required; etc. Charts for 100, 85, and 70 per cent ultimate humidity.

AIRCRAFT

Military, Limitation of. Report of the Sub-Committee on the Limitation of Aircraft. Aerial Age Weekly, vol. 14, no. 23, Feb. 13, 1922, pp. 543–545. Discusses commercial, civil, and military aircraft; impossibility of limitations; gives general summary of conclusions.

AIRCRAFT CONSTRUCTION MATERIALS

Wire Cable, Elasticity of. A Study of the Elastic Properties of Small-Size Wire Cable, R. R. Moore. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 105–106 and 111. Results of series of tests carried out at McCook Field, Dayton, Ohio, in which it is shown that modulus of elasticity of small-sized wire aircraft cable varies from 15,000,000 to 28,000,000, depending upon size and type of cable. It was also found that modulus of elasticity may be raised by loading cable below elastic limit and that resting the cable does not seem to have any definite effect on modulus.

AIRPLANE ENGINES

Air-Cooled. Air-Cooled Engine Development, Charles L. Lawrence. Soc. Automotive Engrs. Jl., vol. 10, no. 2, Feb. 1922, pp. 135–141 and 144, 13 figs. Describes British experiments to improve performance of air-cooled engines for aircraft, which lead eventually to development of aluminum cylinders with steel liners and aluminum cylinder heads with steel cylinder screwed into head. Advantages of these and disadvantages of other types.

Gasoline Tests. Tests of Aeroplane Motor with Different Gasolines, O. J. May and Howard Cooper. Sci. Lubrication, July 1921, pp. 9–13, 4 figs. Describes tests made to show effect of using different grades of gasoline in aeronautical engine operation.

AIRPLANE PROPELLERS

Blade Interference. The Fan Propeller and Blade Interference, M. A. S. Riach. Aeronautical Jl., vol. 26, no. 134, Feb. 1922, pp. 63–80, 7 figs. Considers the special case of a propeller working without axial advance in a fluid, i.e., what has been called the "static" case.

Thrust and Torque Characteristics. Tests on Air Propellers in Yaw, W. F. Durand and E. P. Lesley. Nat. Advisory Committee for Aeronautics Report, no. 113, 1921, 37 pp., 26 figs. Results of tests to determine thrust (pull) and torque characteristics of air propellers in movement relative to air in a line oblique to line of shaft, and specifically when such angle of obliquity is large, as in case of helicopter flight with propeller serving for both sustentation and traction.

AIRPLANES

Fighting. Development of the Fighting Aeroplane, F. M. Green. Aeronautical Jl., vol. 26, no. 134, Feb. 1922, pp. 46–55 and (discussion) 56–62, 7 figs. Developments during war; single- and two-seater planes; particulars as to armament, ability to withstand damage, performance and maneuverability, size, and view.

Flying Boats. See FLYING BOATS.
Gliders. See FLIGHT, Soaring.
Helicopters. See HELICOPTERS.

Model Construction. Construction and Testing of Model Airplanes, Walter S. Diehl. Aviation, vol. 12, no. 9, Feb. 27, 1922, pp. 262–263, 3 figs. Shows that construction of airplane model can be simplified, in order to obtain most reliable test data. N.A.C.A. Technical Note No. 82.

Paris Show. Seventh International Exposition of Aerial Locomotion (VII Exposition internationale de locomotion aérienne) André Lesage. Génie Civil, vol. 79, nos. 22, 23 and 24, Nov. 26, Dec. 3 and 10, 1921, pp. 464–468, 477–485 and 510–515, 41 figs. Discusses exhibit of French official services, materials, testing laboratories, French meteorological and aerial navigation service. Describes different types of airplanes and airplane engines exhibited.

Passenger. The Problem of the Passenger Aeroplane W. D. Beatty. Aeroplane, vol. 22, no. 2, Jan. 11, 1922, pp. 27–28, 1 fig. Deals with comfort of passengers on commercial aircraft. Discusses desirable attributes not yet incorporated in modern machines; military development of airplane; beginning of commercial development; design of detail; noise; ventilation; heating; etc. Paper read before Roy. Aeronautical Soc.

AIRSHIPS

R 38 Disaster. The Loss of the "R 38." Engineering vol. 113, no. 2931, Mar. 3, 1922, pp. 265–266. Editorial discussion of report of Accidents Investigation Sub-Committee of Aeronautical Research Committee. Fundamental error of judgment made in design appears to have been that calculations of staff failed to take into account the aerodynamic forces to which ship would be subjected in flight, and considered only forces and moments due to distribution of weight and buoyancy, including gas pressures.

ALLOY STEELS

Chrome-Molybdenum. Chrome-Molybdenum-Steel Applications From the Consumer's Viewpoint, C. N. Dawe. Forging & Heat Treating, vol. 8, no. 2, Feb. 1922, pp. 109–113. Results of physical tests, comparing medium-carbon, chrome-molybdenum, chrome-vanadium, chrome-nickel and chrome steels, expressed by means of a merit index. Paper read before Soc. Automotive Engrs.

High Elastic Limit. Some Alloy Steels of High Elastic Limit, Their Heat Treatment and Microstructure, Charles M. Johnston. Am. Soc. for Steel Treating Trans., vol. 2, no. 6, Mar. 1922, pp. 500–506, 13 figs. Describes non-high-speed series which are said to be most promising by reason of tensile values given in tables, and by reason by uniform, tough and dense microstructure of heat-treated condition.

Structural, Tensile Properties of. Tensile Properties of Some Structural Alloy Steels at High Temperatures, H. J. French. U. S. Bur. of Standards Technologic Papers, no. 205, Dec. 21, 1921, pp. 77–92, 8 figs. Results of determination of tensile strength, proportional limit, elongation, reduction of area, and strength at fracture throughout range 20 to 550 deg. cent. for four steels containing about 0.38 per cent carbon. Brief reference is made to type of fractures obtained in testing steels at various temperatures, and particular attention is paid to comparison of tensile properties of these alloys at 550 deg. cent.

ALLOYS

Aluminum. See ALUMINUM ALLOYS.
Bearing-Metal. See BEARING METALS.
Chromium. See CHROMIUM ALLOYS.
Copper. See COPPER ALLOYS.

Lead-Thallium. The Constitution of Lead-Thallium Alloys (Réflexions sur la constitution des alliages Plomb-Thallium), Léon Guillet. Révue de Métallurgie, vol. 18, no. 12, Dec. 1921, pp. 758–760,

NOTE.—The abbreviations used n indexing are as follows:
Academy (Acad.)
American (Am.)
Associated (Assoc.)
Association (Assn.)
Bulletin (Bul.)
Bureau (Bur.)
Canadian (Can.)
Chemical or Chemistry (Chem.)
Electrical or Electric (Elec.)
Electrician (Elecn.)
Engineer[s] (Engr.[s])
Engineering (Eng.)
Gazette (Gaz.)
General (Gen.)
Geological (Geol.)
Heating (Heat.)
Industrial (Indus.)
Institute (Inst.)
Institution (Instn.)
International (Int.)
Journal (Jl.)
London (Lond.)
Machinery (Machy.)
Machinist (Mach.)
Magazine (Mag.)
Marine (Mar.)
Materials (Matls.)
Mechanical (Mech.)
Metallurgical (Met.)
Mining (Min.)
Municipal (Mun.)
National (Nat.)
New England (N. E.)
Proceedings (Proc.)
Record (Rec.)
Refrigerating (Refrig.)
Review (Rev.)
Railway (Ry.)
Scientific or Science (Sci.)
Society (Soc.)
State names (Ill., Minn., etc.)
Supplement (Supp.)
Transactions (Trans.)
United States (U. S.)
Ventilating (Vent.)
Western (West.)

4 figs. Describes tests with alloys of various percentages. Gives liquidus curve and micrographs.

Zinc. See ZINC ALLOYS.

ALUMINUM ALLOYS

Calite. Calite—A New Heat Resisting Alloy, G. R. Brophy. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 384–386, 1 fig. Describes properties of new ternary alloy of aluminum, nickel, and iron. See also Iron Trade Rev., vol. 70, no. 10, Mar. 9, 1922, pp. 679–680, 1 fig.

AMMONIA

Vapor Tables. New Ammonia Vapor Tables (Neue Dampftabellen für Ammoniak), E. Altenkirch. Zeit. für die gesamte Kälte-Industrie, vol. 28, no. 12, Dec. 1921, pp. 173–177, 1 fig. Author presents and extends American table prepared by Bur. of Standards, values being changed from Fahrenheit into Celsius and from English into metric units.

AMMONIA COMPRESSORS

Losses in. Analysis of Losses in Ammonia Compressors, S. F. Smith. Ice & Refrigeration, vol. 62, no. 2, Feb. 1922, pp. 154–155. Discusses losses as they occur and conditions which control same.

APPRENTICES, TRAINING OF

Plant vs. Continuation Schools. The Training of Workers in Manufacture, J. V. L. Morris. Am. Mach., vol. 56, no. 7, Feb. 16, 1922, pp. 249–251. General conditions of apprenticeship; problems arising from school; plant school vs. part-time and continuation schools.

AUTOMOBILE ENGINES

Acoustic Volumeters for. The Charron-Godet Acoustic Volumeter (Le volumètre acoustique Charron-Godet), R. Villers. Nature, no. 2493, Jan. 14, 1922, pp. 26–28, 3 figs. Describes apparatus made by Soc. des Accessoires Routiers, used, among other things, for detecting unequal combustion chambers in multi-cylinder engines.

Carburetors. See CARBURETORS.

New York Show. Powerplant Trends as Seen at the Show, Herbert Chase. Automotive Industries, vol. 46, no. 2, Jan. 12, 1922, pp. 62–65, 3 figs. Discusses cooling systems, aids to starting, lubrication and piston design, valves, gearing and crankshafts, etc.

Weidely Six-Cylinder. Weidely Producing a New Engine, J. Edward Schipper. Automotive Industries, vol. 46, no. 10, Mar. 9, 1922, pp. 551–553, 5 figs. Is six-cylinder overhead-valve type, intended for light and medium-weight cars; force-feed lubrication used throughout; crankcase and cylinders cast in block develops 63 hp. at 3000 r.p.m.

AUTOMOBILES

Body-Seating Dimensions. Body Seating-Dimensions, George E. Goddard. Soc. Automotive Engrs. Jl., vol. 10, no. 2, Feb. 1922, pp. 117–120, 1 fig. Considers features conducive of comfort. Factors influencing seat dimensions, and recommendations regarding different desirable dimensions.

Brakes. Automobile Brakes, Sydney V. James. Armour Engr., vol. 13, no. 1, Nov. 1921, pp. 1–21, 9 figs. Discusses mechanics of motion as applied to brakes and braking, actual brake mechanisms and typical braking systems, including both external contracting and internal expanding types, and brake lining materials.

German Maf. The German Maf Automobile (Markranstädter Automobilfabrik, vorm. Hugo Ruppe G.m.b.H., Markranstädt bei Leipzig). Wirtschaftsmotor, no. 9, Sept. 10, 1921, p. 15, 3 figs. on pp. 14 and 16. Describes automobile chassis and engine constructed by the Markränstadt Automobile Factory, near Leipzig, said to be only German car with air-cooled engines. Constructed as sport two-, three- and four-seated car, sport phaeton, landaulet and delivery wagon.

Manufacturing Plants. A Modern Automobile Plant, Paul L. Battey. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 167–172, 8 figs. Arrangement of departments, routing of product, and means of transportation. (Abstract.) Paper presented to Metropolitan Section of Am.Soc.Mech.Engrs.

The New Plant of the Fisher Body Ohio Co. (Cleveland). Power Plant Eng., vol. 26, no. 4, Feb. 15, 1922, pp. 201–209, 13 figs. Largest single-unit automobile-body manufacturing plant in world. Exemplifies modern construction in its highest degree.

New York Show. Trends in Chassis Design at the New York Show, P. M. Heldt. Automotive Industries, vol. 46, no. 2, Jan. 12, 1922, pp. 58–62, 8 figs. Discusses various improvements, including changes in clutch, transmission locks, gear shifting, and steering wheel.

Pressed-Steel Parts. Making Pressed Steel Automobile Parts. Iron Trade Rev., vol. 70, no. 9, Mar. 2, 1922, pp. 601–604, 8 figs. Details of plant of the Sharon Pressed Steel Co., Sharon Pa.

Repair-Shop Practice. Automobile Repair Shop Practice. Machy. (N. Y.), vol. 28, nos. 5, 6 and 7, Jan., Feb. and Mar. 1922, pp. 359–362, 468–470, 7 figs. and 567–568, 2 figs. Describes methods and equipment commonly employed. Feb.: Machining pistons. Mar.: Regrinding crankshaft bearings.

Shock Insulators, Rubber. Rubber Shock Insulators. Rubber Age, vol. 2, no. 12, Feb. 1922, p. 593, 4 figs. Describes tests carried out in London and New York to demonstrate efficiency of rubber insulators in damping vibration and producing easy riding.

Spring-Bolt Lubrication. The Lubrication of Joint Pins, Especially Automobile Spring Bolts (Die Schmierung von Gelenkbolzen insbesondere der Automobil-Federbolzen), R. Bussien. Motorwagen, vol. 25, no. 3, Jan. 31, 1922, pp. 46–47, 9 figs. Describes new type of spring bolt, with use of which problem of lubrication is satisfactorily solved. Oil is fed directly to place of lubrication and dead space between place of lubrication and grease chamber is reduced to a minimum.

Statistics. Automobile Statistics. Automotive Industries, vol. 46, no. 7, Feb. 16, 1922, pp. 309–429. Special number giving statistical data concerning registrations, production, specifications, exports, and general automotive statistics.

Transmission Case. The Wills Sainte Claire Transmission Case, Fred H. Colvin. Am. Mach., vol. 46, no. 9, Mar. 2, 1922, pp. 323–325, 8 figs. Is of "bell" type and bolts direct to end of crankcase. After cleaning and inspecting, it is water-tested for blowholes or leaks and then spotted in three places for locating in future operations.

AVIATION

Commercial. Air Lines and Some of Their Problems, R. B. C. Noorduyn. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 107–109 and 111. Detailed account of progress of commercial aviation in Europe, tracing development from time of post-war experimental work with military machines and fields, to present successful operation with proper machines and schedules and with Government subsidies.

Dead Reckoning, Checking. Methods of Air Navigation, Herbert V. Thaden. Aviation, vol. 12, no. 9, Feb. 27, 1922, pp. 252–255, 6 figs. Formula and instruments for checking dead reckoning.

Requirements and Difficulties. The Requirements and Difficulties of Air Transport, Frank Searle. Aeronautical Jl., vol. 26, no. 133, Jan. 1922, pp. 3–10 and (discussion) 10–20. Discusses requirements of engine, as a source of power, and the plane, both as a device for rising into air, staying in air, and descending from air to land in a satisfactory way; accommodation of travelers; and rapidity and certainty of service at a proper price.

Research. The Progress of Research, R. K. Bagnall-Wild. Engineer, vol. 133, no. 3450, Feb. 10, 1922, pp. 161–162. Research work for air service in Great Britain comprises specific researches at establishments under control of Air Ministry, and in addition an important series of studies carried out in universities by arrangement with the Ministry. Notes on aero-engine research, navigation, and machines. See also Engineering, vol. 113, no. 2929, Feb. 17, 1922, pp. 214–216. Paper read at Air Conference, London.

B

BEAMS

Continuous. Calculation of Continuous Beams (Beitrag zur Berechnung des kontinuierlichen Trägers), Josef Vinzens. Bauingenieur, vol. 2, no. 24, Dec. 31, 1921, pp. 695–698, 6 figs. Calculating method is developed showing how, with aid of known or determined moments of support for uniform load of bays of continuous beam, the influence of another bay-symmetrical load can be directly ascertained without special intermediate calculation.

BEARING METALS

Arsenical. Arsenical Bearing Metals, Harold J. Roast and Charles F. Pascoe. Min. & Metallurgy, no. 182, Feb. 1922, pp. 63–64. Investigation for purpose of comparing arsenical antimony-lead alloy with some of the regular bearing-metal alloys. (Abstract.) See also Am. Inst. Min. & Met. Engrs. Trans., no. 1136-N, Feb. 1922, 10 pp. 7 figs. (complete paper).

BEARINGS, THRUST

Improved Types. Progress in the Construction of Thrust and Journal Bearings (Neuerungen im Bau von Druck- und Traglagern), H. Schneider. Oel- u. Gasmaschine, vol. 18, no. 12, Dec. 1921, pp. 196–199, 9 figs. Describes new types and improvements, including the single-pulley thrust bearings developed by Fried. Krupp Germania Shipyards, which have given such good experimental results that they are to be installed in submarines of the German navy.

BELTING

Leather, Specifications. Outline of U. S. Specifications for Leather Belting, R. C. Bowker. Belting, vol. 20, no. 2, Feb. 1922, pp. 30–31. To be used by all government departments, but designed also for all consumers; now before Bureau of the Budget for consideration. (Abstract.) Address before Nat. Assn. Leather Belting Manufacturers.

Power Transmission by. Transmission of Power in Plant of Mid-West Glass Co., H. Hilman Smith, Jr. Belting, vol. 20, no. 2, Feb. 1922, pp. 26–28, 4 figs. System characterized by line-shafts supported from floor stands driving direct to all machines, latter equipped with tight and loose pulleys.

Width, Determining. Charts for Determining Belt Widths, Thomas J. Cook. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 562–564, 3 figs. Presents charts devised by author which, it is claimed, should enable any one to ascertain at a glance the most efficient size of belt to be used for any condition which may arise.

BLOWERS

Turbo. Turbo-Blowers for Mechanical-Draft Applications. Power, vol. 55, no. 8, Feb. 21, 1922, pp. 307–308, 2 figs. Four blowers are worked in parallel and directly connected to turbine operating at 5000 r.p.m. These machines are applied to both forced- and induced-draft purposes.

BOILER FEEDWATER

Automatic Regulation. Automatic Feed Regulation. Mar. Engr. & Naval Architect, vol. 45, no. 533, Feb. 1922, p. 53, 1 fig. on p. 52. Describes the Mumford automatic feedwater regulator now being fitted on White Star liner "Majestic."

Treatment. Critical Discussion of the Different Methods of Boiler Feedwater Treatment (Kritik der verschiedenen Methoden der Reinigung von Kesselspeisewasser), B. Preu. Dinglers polytechnisches Jl., vol. 337, nos. 1 and 2, Jan. 14 and 29, 1922, pp. 1–4 and 11–13. Discusses criteria for obtaining best possible purification and advantages and disadvantages of different processes.

BOILER OPERATION

Automatic Draft Regulation. Automatic Draft Regulation in Steam Boiler Rooms (La régulation automatique du tirage das les chaufferies de générateurs à vapeur), Jean Delestrade. Technique Moderne, vol. 13, no. 12, Dec. 1921, pp. 510–518, 14 figs. Describes complete operation of a battery of four Babcock boilers, of which one is auxiliary, producing 10,000 kg. steam per hr. at 14.5 kg. pressure.

Present-Day. Present-Day Boiler-Room Operation, I. E. Moultrop and R. E. Dillon. Power, vol. 55, no. 10, Mar. 7, 1922, pp. 384–386, 6 figs. Discusses economical loading of turbines and boilers. Paper read before Metropolitan Sections of Am.Soc.Mech. Engrs. and Am.Inst.Elec.Engrs.

BOILER PLANTS

Design. Common Faults in Boiler-Plant Design, George C. Cook. Power, vol. 55, no. 7, Feb. 14, 1922, p. 251. One of most frequent faults is said to be failure to provide sufficient space. Valves should be accessible. Influence of fuel on design.

Supervision. Supervision of Steam Boiler Plants, H. Germer. Eng. Progress, vol. no. 2, pp. 42–43, 4 figs. Deals with constant-volume, piston disk, Woltmann, venturi and Venturi steam meters.

BOILER ROOMS

Flue-Dust Blowers and Catchers. Flue-Dust Blowers and Catchers, Particularly for Flue Boilers (Flugaschenbläser und Flugaschenfänger, insbesondere für Flammrohrkessel), H. Pradel. Braunkohle, vol. 20, no. 36, Dec. 10, 1921, pp. 564–569, 11 figs. Describes new types by German firms.

BOILERS

Marine. See MARINE BOILERS.

Oil in. Lubrication and the Steam Boiler, Edward L. Gross. Sci. Lubrication, Oct. 1921, pp. 8–9. Discusses oil in steam boiler, and foaming and priming, and the remedies.

Scale Removal with CO_2. Removing Boiler Scale with CO_2, R. J. Cross and Roy Irvin. Power, vol. 55, no. 11, Mar. 14, 1922, pp. 422–423, 1 fig. Some scales are removable by carbonated water. Work done with ordinary "soda-fountain" cylinders of liquid carbon dioxide. Preliminary tests easy to make.

Setting. Large Combustion Chamber in Rear of Boiler, to Which Heated Air Is Admitted, Increases Efficiency, Alphonse F. Brosky. Coal Age, vol. 21, no. 7, Feb. 16, 1922, pp. 288–289, 1 fig. Air heated in flue passing under combustion chamber, is emitted through passages in bridge wall, causing combustion of unburned hydrocarbons and carbon monoxide.

Triple-Riveted Butt Joint. The Designing of a Triple Riveted Butt Joint, L. T. Rutledge. Can. Machy., vol. 27, no. 6, Feb. 9, 1922, pp. 17–19, 1 fig. Strength of boiler shell; sketching proposed joint; resistance against tearing and crushing.

Up- vs. Down-Draft Smokeless. Up-Draft Versus Down-Draft Smokeless Boilers. Heat. & Vent. Mag., vol. 19, no. 2, Feb. 1922, pp. 29–30, 1 fig. Air over fire needed only part of time; rate at which air is demanded; value of preheating air.

BOILERS, WATER-TUBE

Marine. Emergency Fleet Corporation Water-Tube Boilers for Wood Ships, F. W. Dean. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 99–102 and (discussion) p. 104, 6 figs. Results of evaporative tests of four-pass boiler, having heating surface of 2518 sq. ft., furnace volume of 408 cu. ft. and a commercial horsepower of 435 on basis of marine rating of 6 lb. of water to square foot of heating surface per hr.

BONUS SYSTEMS

Heat-Treating Department. A Successful Bonus System Applied to Heat Treating, A. A. Blue. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 430–436, 2 figs. Summarizes general principles and practical details of a successfully tried-out bonus system.

BORING

Spherical Housing. Boring a Spherical Housing on an Automatic Machine, P. J. Tomkins. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, pp. 541–542, 4 figs. Describes the difficulties and how they were overcome.

BRAKES

Bus, Hydraulic. Four-Wheel Hydraulic Brake Tried on California Bus. Elec. Ry. Jl. (Bus Transportation), vol. 59, no. 6, Feb. 11, 1922, p. 123. Brake installed in 18-passenger Pierce-Arrow bus by Pickwick Stage Co., Los Angeles, has proved highly satisfactory so far.

BRONZES

Manganese. The Effect of Solders on Beta Brasses. Eng. Rev., vol. 35, no. 7, Jan. 1922, p. 233. Account of investigations made by J. H. S. Dickenson, commenced in order to account for failure of a manganese bronze, or Beta brass forging of a turbo-alternator.

C

CABLEWAYS

Electric Suspension. Electric Suspension Railways with Self-Acting Grippers, P. Stephan. Eng. Progress, vol. 3, no. 2, Feb. 1922, pp. 34–37, 13 figs. Design and method of working. Describes a Bleichert electric grab suspension railway and a conveying plant for coal and coke.

CAR LIGHTING

Electric. Electric Illumination for Trains, Richard Hanchen. Eng. Progress, vol. 3, no. 1, Jan. 1922, pp. 1–3, 6 figs. Notes on continuous electric train lighting for individual cars; drive of dynamo; voltage control; charging and life of battery, etc.

Principles of Car Lighting by Electricity—XVII, Charles W. T. Stuart. Ry. Elec. Engr., vol. 13, no. 1, Jan. 1922, pp. 9–17, 15 figs. Describes the Gould simplex system of car lighting, consisting of a generator driven by a belt from car axle, a generator regulator panel, a lamp regulator panel mounted in a cabinet inside or under car body, and a storage battery suspended in a box under car body.

CARBON DIOXIDE

Pressure-Total-Heat Diagram. Pressure-Total-Heat Diagram For Carbon Dioxide. H. J. MacIntire. A.S.R.E. Jl., vol. 8, no. 3, Nov. 1921, pp. 211–215, 1 fig. Describes diagram, said to be accurate, clear and workable. Drawn with rectangular coördinates, using pressures for ordinates and total heat in B.t.u. above 32 deg. fahr. as abscissae.

CARBURETORS

Triple-Emulsion Automatic. A New Triple-Emulsion Automatic Carburetor (Un nouveau carburateur a triple emulsion et economiseur automatique), Ach. Delamarre. Outillage, vol. 242, no. 2, Jan. 14, 1922, pp. 48–49, 4 figs. Describes the Paget patent carburetor "Eclipse."

CARS

Hose Connectors. Recent Changes in American Hose Connectors. Ry. Age, vol. 72, no. 6, Feb. 11, 1922, pp. 375–377, 4 figs. Describes connector manufactured by Am. Automatic Connector Co., Cleveland, Ohio, and tests made.

The Development of the Robinson Connector. Ry. Mech. Engr., vol. 96, no. 2, Feb. 1922, pp. 77–81, 9 figs. Latest type incorporates improvements suggested by extensive service of earlier design.

CARS, PASSENGER

Articulated Dining. Articulated Units Feature Recent English Car Design. Ry. Rev., vol. 70, no. 4, Jan. 28, 1922, pp. 109–113, 6 figs. Describes new dining-car train, showing advantages of articulated design and use of electricity for cooking.

Sleeping and Compartment. New Sleeping and Compartment Cars for the C. P. R. Ry. Rev., vol. 70, no. 3, Jan. 21, 1922, pp. 77–81, 8 figs. Designed for service on transcontinental trains with special regard for comfort of women travelers.

CASE-HARDENING

Cyanamide for. Cyanamide in Liquid Case Hardening, P. W. and E. B. Shimer. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 403–408. Account of experiments made with and description of the Shimer case-hardening process, making use of special lump calcium cyanamide and easily fusible mixture of salts.

Steel, Effect of Quality on. Effect of Quality of Steel on Case-carburizing Results, H. W. McQuaid and E. W. Ehn. Min. & Metallurgy, no. 182, Feb. 1922, pp. 60–61. Writer seeks to prove that presence of excess dissolved oxides in steel, as made in melting furnace, affects permanently results obtained in carburizing and hardening and that it is possible that presence of dissolved oxide can result in total unfitness of low-carbon steel for case-hardening purposes. (Abstract.) See also Am. Inst. Min. & Met. Engrs. Trans., no. 1135–S, Feb. 1922, 22 pp. 46 figs. (complete paper.)

CAST IRON

Desulphurization of Liquid. The Desulphurization of Liquid Cast Iron (Entschwefelung von flüssigem Gusseisen), Ludwig Scharlibbe. Giesserei-Zeitung, vol. 19, no. 3, Jan. 17, 1922, pp. 43–46 and (discussion) pp. 46–54, 6 figs. Describes new process for removal of sulphur from molten liquid, resulting in a desulphurization up to 60 per cent of original sulphur content.

Gray, Metallography of. Apply Metallography to Gray Iron, J. W. Bolton. Foundry, vol. 50, nos. 2 and 3, Jan. 15 and Feb. 1, 1922, pp. 52–55 and 109–112, 23 figs. Jan. 15: Describes methods of making photomicrographs, including sampling, polishing, etching and photographing. Shows means for identifying the different structures. Feb. 1: Metallurgical control of cupola.

Piping. The Piping of Cast Iron (Ueber das Lunkern von Gusseisen). Giesserei-Zeitung, vol. 19, no. 5, Jan. 31, 1922, pp. 75–81. Discussion of nature and causes of piping. Abstracts of three papers presented before South German Group of Assn. German Foundrymen, followed by discussion.

Welding Without Studding. Welding Cast Iron Without Studding, F. L. Paertch. Welding Engr., vol. 7, no. 2, Feb. 1922, pp. 28–29 (includes discussion). A process which is feasible in some cases but not recommended for strength members and live loads. Paper read before Am. Welding Soc.

CASTING

Centrifugal. Centrifugal Casting, L. Cammen. Chem. & Met. Eng., vol. 26, no. 8, Feb. 22, 1922, pp. 354–358, 4 figs. Describes process of centrifugal casting of hollow metal objects. Mechanics of centrifugal casting.

Steel Mill Rolls. Rolls Molded in Sectional Flasks, J. R. Hadsum. Foundry, vol. 50, no. 5, Mar. 1, 1922, pp. 206–207, 2 figs. Alternative method to sweep molding. Mold finished in sections and clamped together.

Tunnel Segments. Tunnel Segment Casting Methods. Foundry, vol. 50, no. 4, Feb. 15, 1922, pp. 137–141, 6 figs. Discusses technical difficulties in producing castings for lining of vehicular tunnel under Hudson River.

CENTRAL STATIONS

Operating Expenses. Operating Expenses of Six Plants. Elec. World, vol. 79, no. 3, Jan. 21, 1922, pp. 131–132. Study of Massachusetts stations emphasizes advantages of electrical equipment from upkeep standpoint. Data indicate changes which are taking place as result of transition to new industrial basis.

CENTRIFUGES

Draining Crystals in. Draining Crystals in a Centrifugal Machine, Thomas James Drakeley and George Frank Martin. Soc. Chem. Industry Jl., vol. 40, no. 24, Dec. 31, 1921, pp. 308T–310T, 1 fig. Results of a series of experiments conducted on a large Watson-Laidlaw centrifuge to extract mother liquor from crystals.

CHARTS

Engineering. Practical Engineering Charts, K. F. Smith. Am. Soc. Naval Engrs. Jl., vol. 34, no. 1, Feb. 1922, pp. 56–72, 4 figs. Describes charts for graphical solution of equations with x and y, or z and w given.

CHUCKS

Magnetic. Direct Current or Alternating Current for Magnetic Chucks (Gleichstrom oder Wechselstrom für Spannfutter), B. Wittkuhns. Elektrotechnik u. Maschinenbau (Anzeiger), vol. 40, no. 5, Jan. 29, 1922, pp. 21–22. Results of tests made on magnetic chuck for alternating current to determine its properties when compared with d.c. chucks. It is shown that only advantage of a.c. chuck is the instant demagnetization attained with its use, but there are a great many insurmountable disadvantages.

CHROMIUM ALLOYS

Expansibility. Expansibility of Chromium and Nickel-Chromium Alloys in a Large Interval of Temperature (Dilatabilité du chrome et des alliages nickel-chrome dans un intervalle étendu de températures), P. Chevenard. Comptes Rendus des Séances de l'Académie des Sciences, vol. 174, no. 2, Jan. 9, 1922, pp. 109–112, 2 figs. Describes experiments carried out by means of dilatometer and gives curves resulting.

COAL HANDLING

Equipment. Car Dumper and Coal Conveyors at Coke Oven Plant. Eng. News-Rec., vol. 88, no. 10, Mar. 9, 1922, pp. 407–409, 4 figs. Rotary cradle serves conveying belts. Traveling bridge has belt for storing coal and grab bucket to reclaim it.

Locomotive Loading Plant. Locomotive Coal and Ash Handling Plant. Eng. Rev., vol. 35, no. 7, Jan. 1922, pp. 226–228, 3 figs. Describes plant of Lond. & North Western Ry. Co., capable of loading locomotive in 30 sec.

Unloading Railway Trucks. The Unloading of Bulk Goods (Zur Frage des Umschlages von Massengütern), Hubert Hermanns. Zeit. des Vereines deutscher Ingenieure, vol. 66, no. 5, Feb. 4, 1922, pp. 112–114, 7 figs. Description of the Heinzelmann elevator discharger for the unloading of railway trucks; comparison with tipping devices from economic standpoint.

COMBUSTION

Control. Gas and Air Mixers for Combustion Control, T. L. Hiles. Forging & Heat Treating, vol. 8, no. 2, Feb. 1922, pp. 124–125. Discusses difficulties in producing a perfect combustible mixture of gas and air at burner outlet of a gas furnace.

CONDENSERS, STEAM

Spray-Nozzle Cooling of Condenser Water. Spray-Nozzle Cooling Theory and Practice, B. H. Coffey and G. S. Dauphinee. A.S.R.E. Jl., vol. 8, no. 3, Nov. 1921, pp. 177–202, 6 figs. Discusses the three varieties of variables affecting spray cooling, viz.: independent natural variables which we cannot control; independent artificial variables which we can control; and the final temperature, produced by the mutual reactions of the others and, consequently, the dependent variable.

Testing Apparatus. Testing Condenser Apparatus, R. N. Ehrhart. Power, vol. 55, no. 7, Feb. 14, 1922, pp. 248–250, 7 figs. How commercial tests are made on ejectors, circulating and condensate pumps.

Tubes. British Standard Specification for Condenser Tubes and Screwed Glands for Condensers for Marine Purposes. British Eng. Standards Assn., no. 145, Oct. 1921, 7 pp., 3 figs. Specifications for quality of material, manufacture, dimensions, weight, hydraulic and mechanical tests, inspection and testing facilities.

Properties of Condenser Tubes. Power, vol. 55, no. 9, Feb. 28, 1922, pp. 343–344. Muntz and Admiralty metals are discussed. Discusses the effects of internal strains, crystalline structure and thickness of tubes.

CONNECTING RODS

Bearing Machine for. Universal Bearing Machine for Connecting Rods. Western Machy. World, vol. 13, no. 2, Feb. 1922, pp. 48–52, 15 figs. Designed for use in pouring and boring of bearings for automotive connecting rods. Manufactured by Automatic Bearing Machine Co., San Jose.

CONVEYORS

Advantages. The Influence of Mechanical Conveyors Upon Financial and Operating Policies, W. L. Churchill. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 133–136, 7 figs. It is pointed out that a completely conveyorized plant automatically secures advantage of cost reduction, speedy delivery to customers, minimum capital investment, and a highly stimulated industrial organization.

Steel-Band. Novel Applications for Thin Steel Bands, Bernard Kruger. Iron Age, vol. 109, no. 10, Mar. 9, 1922, pp. 640–642. Special advantages are said to follow their use for power-transmitting and conveying purposes. Question of tension important. Paper presented before West. Soc. of Engrs.

COOLING LIQUIDS

Recooling Plants. Modern Types of Recoolers (Neuere Bauarten von Ruckkühlanlagen), F. Seufert. Zeit. des Vereines deutscher Ingenieure, vol. 65, no. 51, Dec. 17, 1921, pp. 1307–1310, 16 figs. Disadvantages of older types are said to be: excessive delivery head of the hot water, dead air space in lower part of cooling tower, and insufficient atomization of dripping water. These disadvantages are eliminated in modern types. Results of tests.

COOLING TOWERS

Recooling of Water in. The Recooling of Water in Self-Ventilating Tower Coolers (Ueber die Wasserrückkühlung mit selbstventilierendem Turmkühler), Carl Geibel. Zeit. des Vereines deutscher Ingenieure vol. 66, nos. 2 and 4, Jan. 14 and 28, 1922, pp. 31–36 and 88–91, 49 figs. (Abstract.)

COPPER ALLOYS

Copper-Tin-Zinc. Copper—88, Tin—10, Zinc—2, R. R. Clarke. Metal Industry (N. Y.), vol. 20, no. 2, Feb. 1922, pp. 56–57, 1 fig. Analysis of properties, idiosyncrasies and methods of producing this mixture.

Phosphor-Copper. Phosphor-Copper, J. L. Jones. Metal Industry (Lond.), vol. 20, no. 7, Feb. 17, 1922, pp. 145–146. Its uses and methods of obtaining best results.

COST ACCOUNTING

Chemical. Some Phases of Chemical Cost Accounting, C. B. E. Rosén. Chem. Age (N. Y.), vol. 29, no. 12, Dec. 1921, pp. 501–504. Discusses the question of process costs and their management.

Machine-Rate. Machine Rate Costing in Engineering Manufacturing Works, G. W. Beale. Jl. Indus. Administration, vol. 1, no. 8, Dec. 1921, pp. 246–253. Series of arguments leading to the conclusion that it is not commercially profitable to include machine rate costs in the routine-recorded system of cost accounts of an engineering manufacturing works, but that it finds its true place in estimated costs.

CRANES

Electrical Apparatus for. Selection of Electrical Apparatus for Cranes, R. H. McLain. Am. Inst. Elec. Engrs. Jl., vol. 41, no. 3, Mar. 1922, pp. 249–256. Paper is intended to assist crane designers and electrical engineers in mills and factories to select proper size and kind of motor by mathematical calculation from given data, and refers particularly to electric overhead traveling crane. It is shown how to calculate power required of motor for hoisting and how to select particular kind of motor needed.

Locomotive. Getting the Maximum Performance Out of Locomotive Cranes. Ry. Maintenance Engr., vol. 18, no. 2, Feb. 1922, pp. 49–53, 3 figs. Describes the many purposes for which Lehigh Valley R. R. has found it profitable to use them in maintenance-of-way work.

CRANKPINS

Lubrication. An Analysis of a Point in Crank Lubrication. Automotive Industries, vol. 46, no. 8, Feb. 23, 1922, pp. 462–463, 10 figs. Analytical investigation to determine best location for crankpin oil holes.

CRANKSHAFTS

Balancing Machine. A New Crankshaft Balancing Machine, P. M. Heldt. Automotive Industries, vol. 46, no. 9, Mar. 2, 1922, pp. 518–519, 3 figs. Obviates need for preliminary static balance and permits of quickly determining magnitudes and proper angular positions of correcting moments required to insure accurate dynamic balance.

CUPOLAS

Operation and Control. Operation and Control of Cupolas (Conduite et Contrôle des Cubilots), Maurice Bouffart. Fonderie Moderne, no. 12, Dec. 1921, pp. 372–377, 10 figs. Discusses the various chemical and physical measurements, including temperature measurements in melting zone and in charge. Paper read before Congrès de Fonderie de Liége.

CURVES

Polytropic. The Plotting of Polytropic Curves (Ueber Polytropen-Konstruktionen), Emil Wellner. Dinglers Polytechnisches Jl., vol. 336, nos. 24 and 25, Dec. 3 and 17, 1921, pp. 337–339 and 347–350, 13 figs. Method of plotting curves based on the Ebner construction, which permits the finding in a purely geometrical way of curve points at any given ordinate points. Constructions are given for representation of the mechanical work in linear form and for finding mean indicated pressure.

D

DIE CASTING

Uses and Machines for. Die Casting, A. G. Hopkins. Instn. Mech. Engrs. Proc., no. 1, 1922, pp. 25–35 and (discussion) 36–40, 7 figs. Deals with uses and advantages; permanent molds; lead base, zinc base, tin base, aluminum base and copper base alloys; design of dies; die-casting machines.

DIESEL ENGINES

Compressors for. The Use of Compressed Air in Diesel Engined Ships, William Reavell. Engineering, vol. 113, no. 2928, Feb. 10, 1922, pp. 179–183, 26 figs. partly on p. 170. (Abstract.) Paper read before North-East Coast Instn. Engrs. & Shipbuilders.

Efficiency. Efficiency of the Diesel Oil Engine, L. H. Morrison. Power, vol. 55, no. 9, Feb. 28, 1922, pp. 340–341, 3 figs. Diesel engine, unlike all other prime movers, is thermally more efficient at part loads, reason for which is explained.

Marine. Some Problems of Marine Diesel Engine Design, P. Belyavin. North-East Coast Instn. Engrs. & Shipbuilders, advance proof, no. 2211-Q. for meeting Feb. 24, 1922, 29 pp., 25 figs. Discusses important points which have a substantial influence on size, cost and weight of multi-cylinder, two-stroke-cycle Diesel engine.

DROP FORGINGS

Heat Treatment. Heat-treatment of Drop-forgings. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, pp. 554–557, 5 figs. Practice followed and equipment employed, with special reference to furnace design and suitable fuels.

Perfecting. Perfecting a Drop Forging, J. H. G. Williams. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 390–395, 13 figs. Includes photographs showing how metal did not flow in manner originally planned, and discusses methods used for removing conditions promoting formation of defects.

DURALUMIN

Gear Material. Duralumin and Its Use as a Gear Material, Robert W. Daniels. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 542–543. Notes on physical properties and general characteristics of duralumin; process of manufacture. It is said to be an ideal material for worm wheels. (Abstract.) Paper read before Am. Gear Mfrs. Assn.

DYNAMOMETERS

Hydraulic Traction. The Polak Hydraulic Traction Dynamometer. Engineering, vol. 113, no. 2931, Mar. 3, 1922, p. 256, 4 figs. Describes instrument designed by M. W. Polak, Holland, for testing agricultural machinery. It does not draw a curve, but measures average drawbar pull during certain periods, mostly of 20 sec.

E

EDUCATION

American, Foreign Criticism of. Foreign Criticism of American Education, W. J. Osburn. U. S. Dept. of Interior, Bur. of Education Bul., no. 8, 1921, 156 pp. Contains extracts of reports made by educators and critics of education from other countries who have visited American schools, usually for purpose of gaining such information and ideas as would be helpful to them in improvement of schools of their countries.

EDUCATION, ENGINEERING

Industries. Professional Engineering Education for the Industries, Francis, C. Pratt. Eng. Education, vol. 12, no. 5, Jan. 1922, pp. 227–233. Discusses American methods of engineering education, based on result of careful study of large number of college graduates at works of Gen. Elec. Co. Writer is against too early specialization of student, resulting in turning out a disproportionate number of men of mediocre ability and narrowly specialized education.

Metallurgical Course. A University Course in Metallurgical Engineering, W. P. Wood. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 423–425. Presents curriculum prepared by author having in mind preparation of students for those industries which are concerned with final shaping and preparing of metal for use.

Mining Curriculum. The Mining Curriculum at Lehigh University, George J. Young. Eng. & Min. Jl., vol. 113, no. 6, Feb. 11, 1922, pp. 239–242, 8 figs. partly on p. 238. Discusses curriculum.

EDUCATION, INDUSTRIAL

Industries and Railroads. A Review of Industrial Education and Training. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 87–92. Education and Training in the Industries, R. L. Sackett. Education and Training on Railroads, D. C. Buell. Discussion.

ELECTRIC DRIVE

Machine-Tool Shop. Individual Electric Drive in a Machine Tool Shop (La commande électrique individuelle dans un atelier de machines-outils), R. Micheau. Arts et Métiers, vol. 74, no. 10, July 1921, pp. 203–212, 25 figs. Deals with single-pulley drives, cone-pulley drives, and multiple-shaft drives, and their difficulties.

ELECTRIC FURNACES

Electromagnetic Motions in. Electromagnetic Motions in Electric Furnaces, Carl Hering. Am. Electrochem. Soc. advance paper, no. 2, for meeting Apr. 27–29, 1922, pp. 7–14. Describes how new proposed law given in former paper may be applied to production, by the current, of certain desired motions such as those for circulating or stirring liquid conductors in a furnace.

Future Applications. The Electric Furnace Situation. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 137–139. Deals with widening of sphere of electric furnace's operation, including production of cast iron.

Gray-Iron Castings. Electric Furnace Strengthens Iron, D. Wilkinson. Foundry, vol. 50, no. 4, Feb. 15, 1922, pp. 143–145. Reviews work on production of synthetic pig iron, and describes an inexpensive type of electric furnace for gray-iron castings.

Iron Smelting. Electric Iron Smelting. Pacific Mar. Rev., vol. 19, no. 2, Feb. 1922, pp. 126–128, 2 figs. Describes "Elektrometalls" process as carried out at Tröllhattan Falls, Sweden, based on inventions made by Gronwall, Lindblad and Stalhane.

Italian Design. Italian Firm Designs An Electric Furnace. Foundry, vol. 50, no. 5, Mar. 1, 1922, p. 177, 1 fig. Describes electric furnaces placed on market by Fiat Corp., Italian automobile builder, producing 1,000 metric tons of finished steel per month.

ELECTRIC LOCOMOTIVES

Chile. Passenger Locomotives for Chilean State Railways. Elec. Ry. Jl., vol. 59, no. 8, Feb. 25, 1922, pp. 309–314, 18 figs. partly on p. 308. Describes electric locomotives for express and local service on line under electrification between Valparaiso and Santiago. See also Ry. Age, vol. 72, no. 9, Mar. 4, 1922, pp. 527–528, 3 figs.

Driving Gears. New Driving Gear for Electric Locomotives (Neuer Antrieb für elektrische Lokomotiven), H. Hoepner. Verkehrstechnik, vol. 38, no. 35, Dec. 15, 1921, pp. 547–548, 2 figs. Describes new transmission system, tests on a model of which are being conducted by the Campagnie Paris-Lyon-Mediterannée in their Paris workshops; results thus far are very satisfactory.

The Driving Gear of Electric Locomotives (Het mechanische gedeelte van het drijfwerk van electrische locomotieven en motorwagens), H. S. Hallo. Ingenieur, vol. 37, no. 2, Jan. 14, 1922, pp. 24–37, 27 figs. Discusses the Batchelder, Chicago-Milwaukee-St. Paul, Westinghouse flexible, General Electric spring gears, and other types.

ELECTRIC WELDING

Cyc-Arc. The "Cyc-Arc" Process of Automatic Electric Welding, L. J. Steele and H. Martin. Instn. Elec. Engrs. Jl., vol. 60, no. 305, Jan. 1922, pp. 136–157 and (discussion) 158–162, 14 figs. Detailed description of the processes, by which metals of widely differing character and section can successfully be welded electrically.

Steel Construction. Electric Welding Applied to Steel Construction, with Special Reference to Ships, A. T. Wall. Engineering, vol. 113, no. 2930, Feb. 24, 1922, pp. 241–244, 14 figs. Writer calls attention to various ways in which electric welding is being applied to ship construction, and indicates further possibilities in this connection for steel structures. Paper read before Instn. Mech. Engrs.

ELECTRIC WELDING, ARC

Cast Iron. Arc-welding of Cast Iron. Machy. (Lond.), vol. 19, no. 490, Feb. 16, 1922, pp. 593–596, 6 figs. Use and application of methods for welding cast iron by electric arc.

Practical Points. Practical Points in Arc Welding, J. A. Wilson. Am. Mach., vol. 56, no. 10, Mar. 9, 1922, pp. 357–358, 4 figs. Notes on keeping work clean; beveling edges; allowing for expansion and contraction; guarding against injury; making solid welds.

Refrigerating Machinery. Arc Welding of Refrigerating Machinery, A. M. Candy. Welding Engr., vol. 7, no. 2, Feb. 1922, pp. 21–23, 9 figs. Advantages in repair and production work. Paper read before Am. Soc. Refrig. Engrs.

ELECTRICAL MACHINERY

Manufacturing Plant. The Works of the General Electric Company at Witton. Engineering, vol. 113, no. 2928, Feb. 10, 1922, pp. 166–167, 4 figs. Recent extensions at Witton comprise new switchgear shops and shops for manufacture of standard sizes of electric motors, molded insulation works and enameling and plating shops, etc.

ELEVATORS

Motor Controller. Operation of a Drum-Type, Elevator-Machine Alternating-Current Motor Controller, William Zepernick. Power, vol. 55, no. 8, Feb. 21, 1922, pp. 295–298, 9 figs. Functions of different parts and circuits of a one-speed elevator controller. Tracing out circuits for one direction of machine.

Passenger, Safeguarding. Passenger Elevator Protection, J. J. Lamb. Power Plant Eng., vol. 26, no. 4, Feb. 15, 1922, pp. 231–234, 3 figs. Arrangement and safeguarding to prevent accidents and reduce fire hazard to a minimum.

EMPLOYEES' REPRESENTATION

Shop Committees. How Shop Committees Function Under Depression, Lionel D. Edie. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 92–95. Account of what happened to shop committees of Int. Harvester Co., and how these committees have handled lay-offs and wage reductions. Record includes wage cut of 20 per cent decided entirely by shop committees.

EMPLOYEES, TRAINING OF

Manufacturing. The Training of Workers in Manufacture, J. V. L. Morris. Am. Mach., vol. 56, no. 9, Mar. 2, 1922, pp. 320–322. Apprenticeship practices regarding indenture, age, payment and certificates. Public school substitutes. Evening, part-time and coöperative schools.

Methods. Making Industrial Improvements Permanent, Paul M. Atkins. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 153–158, 4 figs. Through patient teaching based on written instructions. Two classes of employee instruction. Specific forms of training.

EMPLOYMENT MANAGEMENT

Eye Examinations. Better Work and More Work per Man Through Better Sight, E. LeRoy Ryer and Willard B. Fisher. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 111–117, 2 figs. Industrial eye examinations and their importance in management.

Principles Involved. Increasing Man Power Through Management, L. W. Olson. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 88–91. Writer discusses cardinal principles involved in management of men.

Testing Motormen. Psychological Tests for Motormen, Alfred Gradenwitz. Elec. Ry. Jl., vol. 59, no. 4, Jan. 28, 1922, pp. 143–146, 13 figs. Discusses physical and psychological tests which must be passed by candidates for position of motormen in Berlin.

ENGINEERING

Economics of. The Economics of Engineering, H. W Pitt. Eng. Production, vol. 4, nos. 73 and 74 Feb. 23 and Mar. 2, 1922, pp. 173–175 and 197–199 Feb. 23: Deals with design economics; production and consumption cost; designing for a given market; standardization and accuracy as cost reducers; designing and costing. Mar. 2: Designer and consumer; production and factory economics; division of labor; economics of purchasing and of selling and using.

ENGINEERING SOCIETIES

German, Alliance of. The Alliance of the Engineering and Scientific Associations of Germany (Zusammenschluss der technisch-wissenschaftlichen Vereine Deutschlands). Gewerbefleiss, vol. 100, no. 12, Dec. 1921, pp. 344–346. Account of alliance of nearly all of the German technical and scientific societies into an organization known as Deutscher Verband (German Federation).

ENGINEERS

Licensing. Licensing and Engineering Ethics, C. E. Waddell. Professional Engr., vol. 7, no. 1, Jan. 1922, pp. 8–9. Status of the expert witness, contractor, manufacturer, salesman, college graduate and practicing engineer.

EVAPORATORS

Basic Principles. Evaporators—What They Are and How They Operate. Power, vol. 55, no. 8, Feb. 21, 1922, pp. 292–294, 3 figs. Writer seeks to present clear idea of basic principles of evaporators as used in power plants to produce distilled makeup water.

F

FACTORIES

Fire and Burglary Protection. Protection against Burglary in Factories by Means of Organization (Fabrikdiebstahlschutz durch Betriebsorganisation). H. Sauter. Betrieb, vol. 4, no. 7, Feb. 14, 1922, pp. 218–226, 16 figs. Describes organization of the Ludwig Loewe & Co., Berlin, which is said to greatly aid in detection of burglars and in prevention of theft.

Safety Arrangements in Factories (Sicherheitseinrichtungen in Fabrikbetrieben), R. Bügler. Betrieb, vol. 4, no. 7, Feb. 14, 1922, pp. 205–209, 20 figs. Describes electric installations and devices for protection against fire and burglary.

Vacuum Cleaning. Vacuum Cleaning Applied to Industrial Plants, Charles L. Hubbard. Factory, vol. 28, no. 3, Mar. 1922, pp. 285–288, 6 figs. Discusses applications in factories and selection of proper type of vacuum cleaner for given conditions,

FACTORY MANAGEMENT

See INDUSTRIAL MANAGEMENT.

FLIGHT

Soaring. A German View of Soaring Flight. Aeroplane, vol. 22, no. 1, Jan. 4, 1922, pp. 8–10, 4 figs. Discusses development of small sporting-type machines, development of new methods of light construction, and educational value of work done as tending to improve aeronautical construction generally.

Soaring Flight and Soaring Aircraft. Aviation, vol. 12, nos. 7 and 8, Feb. 13 and 20, 1922, pp. 195–198 and 224–225, 3 figs. Review of progress achieved in soaring flight and considerations of its practical possibilities.

Soaring Flight, Its Development and Prospects, Wm. Knight. Aerial Age, vol. 14, no. 24, Feb. 20, 1922, pp. 562–563, 8 figs. Describes Klemperer and Loessl gliders, and gives tables of distances and time of flights made.

FLUIDS

Adiabatic Liquefaction. Adiabatic Liquefaction of Fluids (La liquefaction adiabatique des fluides), Jean Villey. Comptes Rendus des Séances de l'Academie des Sciences, vol. 173, no. 26, Dec. 27,

1921, pp. 1453–1455. Confirms calculations by Bruhat, that heat of vaporization of a liquid tends towards a limit L_0, not zero, at absolute zero, and that whatever the initial state, adiabatic expansion must always lead to liquefaction.

FLYING BOATS

Double-Pontoon Airplanes vs. Flying Boats versus Double-Pontoon Airplanes (Zur Frage: Flugboot oder Zweischwimmerflugzeug?), E. Meyer. Motorwagen, vol. 25, no. 2, Jan. 20, 1922, pp. 33–34. Describes Dornier commercial flying boat, type Do.Cs.II 1920, a single-engine, strutless all-metal monoplane with following characteristics: span, 17 m.; surface depth, 3 m.; height, 2.75 m.; length, 10.25 m.; supporting surface, 47 sq. m.; engine, 185-hp. BMW; weight empty, 1350 kg., loaded, 650 kg.; speed, 150 km. per hr., etc.

FOREMEN

Requirements and Training. Can Foremanship Help to Rebuild Profits? B. M. Nussbaum. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 155–159. Notes on cost saving and the foreman; foremen as advisers to directors; training and requirements of good formanship.

FOUNDRIES

Conveying and Mechanical Handling. Conveying and Mechanical Handling in the Foundry. Metal Industry (Lond.), vol. 20, no. 6, Feb. 10, 1922, pp. 123–127, 3 figs. Emphasizes necessity of keeping foundry handling costs at a minimum, and discusses various means to this end.

Dust Removal from Cleaning Room. Removing the Dust from the Casting Cleaning Room, C. C. Hermann. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 171–174, 3 figs. Design of suitable system requires competent consideration of (1) suction at hoods; (2) friction losses in piping; (3) selection of blower unit; (4) discharge resistance; (5) losses due to collector.

Gas Application in. The Application of Gas in the Foundry. Foundry Trade Jl., vol. 25, no. 286, Feb. 9, 1922, pp. 97–100, 7 figs. Describes way in which Mond gas generated at works of Nat. Gas Engine Co., Ltd., is fully utilized. Plant consists of a gas generator, scrubber, gas purifier, exhauster and pressure regulator.

Machine-Tool Industry. Machine Builder Erects Foundry, Pat Dwyer. Iron Trade Rev., vol. 70, no. 10, Mar. 9, 1922, pp. 683–686, 7 figs. Melting and crane equipment was installed sufficient to handle single castings up to 50 tons and daily normal output of 100 tons of castings. Details of new foundry of Toledo Machine & Tool Co., Toledo, Ohio.

Modern Designs. Modern Foundries, M. Fischer. Eng. Progress, vol. 3, no. 2, Feb. 1922, pp. 29–32, 14 figs. Principles governing construction of modern foundries as regards initial costs, enlargement, workmen, and auxiliary arrangements.

White Enameled Interior. Washable White Enameled Foundry Interior. Can. Foundryman, vol. 13, no. 2, Feb. 1922, pp. 17–19, 1 fig. Describes foundry of Waterous Engine Works Co., Brantford, Ont.

FREIGHT HANDLING

Container System. Container System Creates Freight Service. Ry. Age, vol. 72, no. 8, Feb. 25, 1922, pp. 475–476, 5 figs. Describes practice of Cincinnati, Lawrenceburg & Aurora. Inauguration of a demountable body or unit container system in conjunction with motor trucks, and establishment of a small off-track station for handling of these containers.

Containers Carry Freight in Cincinnati. Elec. Ry. Jl., vol. 59, no. 8, Feb. 25, 1922, pp. 315–318, 8 figs. An interurban electric railway without tracks downtown gives through freight service by containers which are carried on motor trucks within city and on electric cars for interurban run.

Electric Tractors and Trailers. Modern Methods of Handling Package Freight, G. Marks. Ry. Age, vol. 72, no. 8, Feb. 25, 1922, pp. 469–470. Use of electric tractors and trailers in freight houses, and savings effected on New Haven line. (Abstract.) Paper read before New Eng. R. R. Club.

Erie Railroad. Erie Adopts Direct Freight Delivery at New York. Ry. Age, vol. 72, no. 3, Jan. 21, 1922, pp. 233–234, 1 fig. Plan involves breaking bulk at Jersey City, N. J., and use of auto trucks, tractors and trailers and ferries.

FUELS

Gas. Burning Fuel Gases Efficiently, H. S. Watts. Iron Trade Rev., vol. 70, no. 9, Mar. 2, 1922, pp. 605–609, 2 figs. Combustion temperature and stack loss are important factors from standpoint of economy. Design and operation of gas burners and principles of continuous heating are discussed.

Fuel Gases and Their Use in Iron and Steel Plants, H. S. Watts. Assn. Iron & Steel Elec. Engrs., vol. 4, no. 2, Feb. 1922, pp. 97–126, 5 figs. Characteristics of gases; design and operation of gas burners; principles of continuous heating.

High-Ash Coal. Low-Ash Coal Not Always Desirable, S. W. Flagg. Power, vol. 55, no. 9, Feb. 28, 1922, pp. 328–330, 4 figs. Discussion of conditions under which it was found that coal with high ash content reduced stoker trouble.

Sawmill Refuse. Generating Power from Waste, H. S. Bastian. Elec. World, vol. 79, no. 8, Feb. 25, 1922, pp. 373–375, 5 figs. "Hogged fuel," or sawmill refuse, proves to be a valuable combustible in lumber-producing regions; care must, however, be exercised in firing if best results are to be obtained.

Vegetable Gas. The Gasification of Vegetable Wastes According to the Process of the German Gas Corporation, Hannover (Germany) (Vegetabilienvergasung nach dem Verfahren der Deutschen Gas-Akt.-Ges., Hannover). Wärme- u. Kälte-Technik, vol. 24, no. 1, Jan. 1922, pp. 5–7, 2 figs. Discusses gasification of tanbark waste, broken hemp stalks, cocoa-bean shells, olive-seed hulls, as well as the hulls of leguminous plants, and gives analyses and thermal values of vegetable gas.

[See also LIGNITE; OIL FUEL; PULVERIZED COAL.]

FURNACES, ANNEALING

Sheet and Tin Mill. Sheet and Tin Mill Furnaces, T. J. Costello and J. H. Knapp. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 141–144, 3 figs. Improvements in furnaces used for heating and annealing sheet and tin.

FURNACES, BOILER

Burners for Blast-Furnace Gas. Tests with Gas Burners on Boilers and Cowpers (Versuche mit Gasbrennern an Kesseln und Cowpern), Eduard Weymann. Stahl u. Eisen, vol. 42, no. 6, Feb. 9, 1922, pp. 215–221, 11 figs. Investigation of different burners for blast-furnace gas for heating of fire-tube boilers and Cowper stoves and description of their arrangement and operation. Comparison of test results. Behavior of burners with fluctuating gas pressures. Describes new American arrangement for regulation of air inlet with fluctuation of gas pressure.

Gas-Fired. The Economic Burning of Excess Gas (Die wirtschaftliche Verfeuerung von Ueberschussgas), M. Schimpf. Glückauf, vol. 58, no. 3, Jan. 21, 1922, pp. 72–76, 8 figs. Account of test carried out at a German mine with a Moll gas-fired furnace and gas-pressure regulator. Demonstrates with aid of numerical example savings which can be effected with use of a regulated gas pressure.

Low-Grade Fuel. The New Mechanical Bamag Furnaces (Die neuen mechanischen Bamag-Feuerungen), H. Pradel. Braunkohle, vol. 20, no. 30, Oct. 29, 1921, pp. 472–476, 5 figs. Describes forced-draft traveling grates and underfeed furnaces of the Berlin-Anhalt Machine Construction Corp., Dessau, for utilization of lignite.

FURNACES, FORGING

Types. Discussion of Forge Furnaces, Charles Longenecker. Forging & Heat Treating, vol. 8, no. 2, Feb. 1922, pp. 122–124. Discusses soaking pits, regenerative-type furnaces, non-regenerative type, and furnaces of small hearth area, pointing out possibilities for saving and increased efficiency with various classes of fuel.

G

GAS

By-Product. Value of By-Product Gas to Industry, H. Dobrin. Assn. Iron & Steel Elec. Engrs., vol. 4, no. 2, Feb. 1922, pp. 79–90 and (discussion) 91–96. Flame temperatures of various gases; use of by-product gas in glass, iron, boiler, and automobile works; furnace design; combustion.

Fuel. See FUELS, Gas.

GAS ENGINES

Manufacture of Parts. How Large Engine Parts Are Made, Pat Dwyer. Foundry, vol. 50, nos. 2 and 3, Jan. 15 and Feb. 1, 1922, pp. 66–73 and 114–119, 18 figs. Jan. 15: Molding practice at plant of Allis Chalmers Co., West Allis, Wis., in production of what are claimed to be largest gas engines in world. Feb. 1: Handling of large engine castings after they are made.

GAS PRODUCERS

Benoid Automatic. Benoid Gas Producer. Eng. Progress, vol. 3, no. 2, Feb. 1922, pp. 37–38, 2 figs. Arrangement, drive and operation of an automatically acting gas producer; properties of gas suitable for illuminating and heating purposes.

Coupled to Gas-Engine Plant. Some Observations on a Producer-Gas Power Plant, H. S. Denny. Engineering, vol. 113, nos. 2926, 2927 and 2928, Jan. 27, Feb. 3 and 10, 1922, pp. 119–122, 152–154, and 184, 10 figs. Account of investigation of large-capacity Mond gas-producer plant coupled up to gas-engine plant of equivalent size. Paper read before Instn. Mech. Engrs. For discussion, see no. 2928, Feb. 10, pp. 160–162.

GAS TURBINES

Economy. Economy and the Gas Turbine, Norman Davey. Engineer, vol. 133, no. 3451, Feb. 17, 1922, p. 177. Gives comparative analyses of gas-turbine cycles (heat absorption at constant pressure) working with common rotary compressor and with kinetic compressor. Writer maintains that gas turbine competes essentially with steam turbine. (Letter to editor.)

Efficiency, Determination of. Thermodynamic Bases for Determining Efficiency to be Expected from Gas Turbines, H. Schmolke. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 187–190, 4 figs. Presents, among others, diagrams developed by W. Schüle showing process and efficiency of Holzwarth turbines. Translated from Zeit. für Dampfkessel u. Maschinenbetrieb, vol. 44, no. 44, Nov. 4, 1921, p. 351.

GASES

Heat Transfer Between Liquids and. Rates of Absorption and Heat Transfer between Gases and Liquids, W. G. Whitman and J. L. Keats. Jl. Indus. & Eng. Chem., vol. 14, no. 3, Mar. 1922, pp. 186–191, 3 figs. Presentation of theory involved in liquid-gas interactions. Summary of Lewis' mathematical treatment with modifications. Verification of theory. Presentation of equations showing effect of operating variables on coefficients for various types of apparatus.

Specific Heat. The Specific Heats of Ammonia, Sulphur dioxide and Carbon dioxide, J. R. Partington and H. J. Cant. Lond., Edinburgh, and Dublin Philosophical Mag. & Jl. of Sci., vol. 43, no. 254, Feb. 1922, pp. 369–380, 2 figs. Experimental results of investigations carried out with object of obtaining reasonably accurate data for use in theoretical discussion.

GEAR CUTTING

Multiple Shaper. Develops Multiple Shaper for Internal Gears. Iron Age, vol. 109, no. 9, Mar. 2, 1922, pp. 592–593, 4 figs. Down-stroke model supplements previous machine of Stevenson Gear Co., Indianapolis; essential features retained.

Planing Spur Gears. Planing Large Spur Gears, Franklin D. Jones. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 529–532, 6 figs. Application of gear planers which cut gear teeth by reproducing shape of templet.

Tooth-Chamfering Machine. Gear Tooth Chamfering Machine. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, p. 558, 4 figs. Describes machine built by Parkinson & Son, Shipley. Effect of chamfer on engagement of gears.

Worm-Gear Generator. A New Worm Gear Generator. British Machine Tool Eng., vol. 2, no. 13, Jan.-Feb. 1922, pp. 439–445, 9 figs. Describes 12-in. worm-gear generator of Smith & Coventry, Ltd., Manchester.

GEARS

Bevel-Gear Testing Machine. The Saurer Bevel Gear Testing Machine. Engineering, vol. 113, no. 2930, Feb. 24, 1922, pp. 228–229, 9 figs. Bed of machine is heavy, circular casting, upon which a pair of sliding heads can be locked in any position, so that angle between axes of heads corresponds to that of bevels to be tested, a range from 52 to 150 deg. being obtainable.

Chain. The Application of Chain Gearing, H. T. Hildage. Can. Manufacturer, vol. 42, no. 2, Feb. 1922, pp. 31 and 51. When adaptable to certain needs; type of chain required; what it will cost; how much space it will occupy; how long it will last.

Friction. Friction Gearing, Chas. S. Pettit. Machy. (Lond.), vol. 19, no. 489, Feb. 9, 1922, pp. 567–569. Discusses frictional contact between driving and driven members; coefficient of friction; pressures of contact; variable-speed disc drives; cup and cone friction clutches; etc.

Herringbone. Standardization of Herringbone Gears, Am. Mach., vol. 56, no. 9, Mar. 2, 1922, pp. 329–330, 2 figs. Recommendations which are result of careful investigation by committee of Am. Gear Mfrs. Assn.

Hot-Rolling. Forming Gears by Hot Rolling, Reginald Trautschold. Iron Trade Rev., vol. 70, no. 6, Feb. 9, 1922, pp. 396–399, 6 figs. Independent application of power to die roll and gear blank and synchronization of their rotation are said to be factors contributing to success of gear-rolling processes.

Spiral Bevel. End Thrusts and Bearing Loads due to Spiral Bevel Gears. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, pp. 545–548, 4 figs. Discusses pinion-cut left-hand spiral, rotating clockwise; pinion-cut left-hand spiral, rotating counter-clockwise; pinion-cut right-hand spiral, rotating clockwise; and pinion-cut right-hand spiral, rotating counter-clock-wise.

GRINDING MACHINES

Plain. A New Precision Grinding Machine. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, pp. 532–534, 5 figs. Plain grinder with positive-acting table traverse and reversing mechanism.

H

HEAT PUMPS

Evaporators and. Experiences with Evaporators in Connection with Heat Pumps (Erfahrungen an Eindampfanlagen mit Wärmepumpe), E. Wirth. Zeit. des Vereines deutscher Ingenieure, vol. 65, no. 46, Nov. 12, 1921, pp. 1183–1186, 11 figs. Points out that as economy of evaporation with liquid concentration is based on a minimum consumption of power, it is necessary to carefully investigate all conditions influencing increase in temperature of vapor. Whereas until now investigations have been made only with regard to liquids with low boiling point, data are here given with heavier liquids. Account of author's experiences during several years with heat-pump operation.

HEATING

Central Producer-Gas Plant. Central Heating by Steam, Water or Gas, Samuel R. Lewis. Power, vol. 55, no. 7, Feb. 14, 1922, pp. 267–268. Central producer-gas plant with automatic gas-fired boilers in each building shows an estimated saving in initial investment of $173,000 and a reduction in annual operating expense of $14,700 over steam heating.

Gas. Possibilities of Gaseous Heating, H. H. Clark. Western Soc. Engrs. Jl., vol. 27, no. 2, Feb. 1922, pp. 51–56 and (discussion) 56–58, 5 figs. Relative combustion efficiency of the various gases assuming perfect combustion; comparison of costs of various fuels; comparison of gas and electricity for heating, power and light. Gives a number of charts.

HEATING, HOT-AIR

Reversed Heat Engine. The Reversed Heat Engine as a Means of Heating Buildings, T. B. Morley.

Engineer, vol. 133, no. 3450, Feb. 10, 1922, 145–146, 1 fig. Recapitulates and explains Lord Kelvin's proposal, made in 1852, of an indirect process employing a heat engine and a "warming machine" driven by engine, by means of which heat delivered to building might be much greater than heat of combustion of coal consumed. Discusses its theoretical possibilities and nature of difficulties to be overcome in its application.

HEATING, HOT-WATER

Thermometers for. Thermometers for Tenements with Hot-Water Heating (Wärmemesser für Mietswohnungen mit Warmwasserheizung), H. Wittfeld. Gesundheits-Ingenieur, vol. 45, no. 3, Jan. 21, 1922, pp. 25–26, 1 fig. Describes device for determining amount of total costs of heating which falls to each apartment according to the actual amount of heat consumed, in order to do away with present method of determining this cost according to surface area of heated rooms.

HEATING, STEAM

Dry Air with. "Dry Air" with Central Heating ("Trockene Luft" bei der Zentralheizung), R. Garz. Wärme- u. Kälte-Technik, vol. 24, no. 1, Jan. 1922, pp. 4–5. Points out that not the absolute, but the relative moisture content changes with the heating of air, as the absorptivity for steam increases; this change is the same in all heating systems; consequently the idea that central and especially steam heating "dries out" the air more than other heating systems is erroneous.

HEAVY-OIL ENGINES

Naphthalene. Naphthalene Engines (Moteurs a naphthaline), P. Maréchal. Nature, no. 2493, Jan. 14, 1922, pp. 22–23, 1 fig. Describes operation of a recent type in which fuel is vaporized by gasifying at low temperature, which makes engine run smoothly.

HELICOPTERS

Problems. Some Notes on the Helicopter, M. B. Sellers. Aviation, vol. 12, no. 8, Feb. 20, 1922, pp. 228–230, 5 figs. Elements of the problem; some experimental results; difficulties yet awaiting solution. N.A.C.A. Technical Note, No. 47, Apr. 1921.

HYDRAULIC TURBINES

Draft-Tube Designs. A Discussion of Draft-Tube Designs, Webster K. Ramsay. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 171–176, 11 figs. With special reference to recent forms known as hydraucone regainer and spreading draft tube.

Flow in Conical Draft Tubes. Flow in Conical Draft Tubes of Varying Angles, George E. Lyon. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 177–180, 7 figs. Account of investigation to determine velocity curves at several cross-sections of straight conical draft tubes.

Measuring Efficiency. New Methods for Measuring the Efficiency of Hydraulic Turbines (Note sur un nouveau procédé de mesure du rendement des turbines hydrauliques), L. Barbillion and A. Poirson. Bul. Technique de la Suisse Romande, vol. 48, no. 2, Jan. 21, 1922, pp. 19–21, 1 fig. Describes thermometric method by which losses are measured from temperature difference of water before and after passing turbine.

HYDROELECTRIC DEVELOPMENTS

Canada. A Review of Hydroelectric Progress in Canada. Can. Engr., vol. 42, no. 8, Feb. 21, 1922, pp. 241–244, 3 figs. Progress in development during 1921. 300,000 hp. installed in Dominion, with 177,000 hp. in Ontario and 90,000 hp. in Quebec.

Muscle Shoals, Ala. The Disposal of Muscle Shoals, R. S. McBride. Power, vol. 55, no. 8, Feb. 21, 1922, pp. 288–291, 4 figs. Notes on existing nitrate and power plants; Ford's offer and Secretary Weeks' objections; Alabama Power Co.'s offer. Author has endeavored to avoid expressing opinions, but has merely suggested basis for various arguments pro and con.

Ontario System. Hydroelectric System of Province of Ontario Investigated, W. S. Murray. Elec. World, vol. 79, no. 10, Mar. 11, 1922, pp. 471–474. In report made public by Nat. Elec. Light Assn., writer finds it inefficient, expensive and wasteful and that, in spite of all claims made for it, service from private utilities in United States and Canada is cheaper and better.

Shawinigan Falls, Canada. The New 41,000 Hp. Unit at Shawinigan Falls, Julian C. Smith. Eng. Jl. (Eng. Inst. Can.), vol. 5, no. 3, Mar. 1922, pp. 134–139, 7 figs. Describes design features of latest hydroelectric development of Shawinigan Water & Power Co.

St. Lawrence River. St. Lawrence Navigation and Power Investigation. Can. Engr., vol. 42, no. 3, Jan. 17, 1922, pp. 139–145, 1 fig. Details of double development plan as proposed by New York & Ontario Power Co. Suggestions based on 14 years' study of conditions in vicinity of Waddington. Proposed sites at Rapid du Plat and Long Sault.

HYDROELECTRIC PLANTS

High-Head. Highest Head Hydroelectric Power Installations of the World, A. T. Parsons. Jl. Electricity & Western, vol. 48, no. 4, Feb. 15, 1922, p. 155. Discusses limiting factors entering into design and construction of hydroelectric plants for very high heads.

Interconnection of Steam and. Michigan a Leader in Interconnection of Hydro and Steam Plants, Harry J. Burton and William W. Tefft. Elec. World, vol. 79, no. 7, Feb. 18, 1922, pp. 328–331, 2 figs. Twenty water-power and eleven steam stations joined by Consumers' Power Company's 140-Kv. transmission system. Bearing of hydro experience on Middle Western developments. How some problems have been solved.

Spain. Hydroelectric Installations in Spain, Horace F. Parshall. Engineering, vol. 113, no. 2928, Feb. 10, 1922, pp. 167–168. Installations of Barcelona Traction, Light & Power Co. (Abstract.) Paper read before Instn. Civ. Engrs.

I

ICE PLANTS

Electrically Operated. 300-Ton Ice Factory at Grimsby. Engineer, vol. 133, no. 3451, Feb. 17, 1922, pp. 171–173, 5 figs. Describes what is believed to be largest electrically operated direct-expansion ice-making plant in world, recently erected and put to work for Standard Ice & Cold Storage Co., Ltd., by Pluperfect Refrigeration Co., Ltd., Manchester, England.

Central Station Service in the Ice Industry, H. M. Jones. Ice & Refrigeration, vol. 62, no. 2, Feb. 1922, pp. 136–138. Electric drive for ice-making plants; power required; kind and size of motors; comparative cost of operating.

Railway. Establishing Icing Facilities on a Large Scale, W. C. Phillips. Ry. Age, vol. 72, no. 9, Mar. 4, 1922, pp. 533–534, 2 figs. System recently inaugurated on Southern Pacific and Union Pacific gives highly satisfactory results.

IMPACT TESTING

Endurance Tests. Impact Endurance Tests of Rods of Varying Cross-Section. Engineering, vol. 113, no. 2930, Feb. 24, 1922, p. 246. Describes endurance tests to which W. Müller and H. Leber, of the Material Testing Bureau at Darmstadt, Germany, have been submitting rods of varying cross-section. Translated from Zeit. des Vereines deutscher Ingenieure (pp. 1089–1094, 1921).

Notched-Bar Tests. Shock Test on Notched Bars (Zur Gesetzmässigkeit der Kerbschlagprobe), M. Moser. Stahl u. Eisen, vol. 42, no. 3, Jan. 19, 1922, pp. 90–97, 21 figs. Influence of thickness of test pieces on notched-bar impact values; relation of shock effect to unit of volume; characteristic of volume; influence of speed of blows; and of diameter of notch. Conclusions based on tests.

INDUSTRIAL MANAGEMENT

Forms. The Principles of Designing Forms, H. P. Losely. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 158–160, 3 figs. Presents and discusses five principles governing design and use of forms.

Inventory Methods. How to Cut Cost Corners Through Inventory, W. M. Romig. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 86–87, 2 figs. How well-managed inventory methods help to stabilize profits.

Labor-Routine Chart. Labor Routine. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 176–177. Presents chart developed for Todd Dry Dock & Constr. Co. by William C. Bober showing how systems of routine may be charted to bring out each step.

Planning. Planning in Large Contract Plants, George H. Shepard. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 547–551, 13 figs. Cards and records used in planning and dispatching work.

Production Control. The Measurement of Human Work, Walter N. Polakov. Management Eng., vol. 2, no. 2, Feb. 1922, pp. 91–93, 1 fig. The Gantt graphic method of controlling production is claimed to be only one on a correct unit of measurement.

Production Organization. Organization of Production, J. W. Curtis. Eng. & Indus. Management, vol. 7, nos. 5 and 7, Feb. 2 and 16, 1922, pp. 127–130 and 187–191, 19 figs. Discusses use of charts, and organization in erection work. Presents scheme of organization of engineering department of a medium-size works. Drawing office progress chart.

Purchasing Policies. Stabilizing Profits through Proper Purchasing Policies, Park Mathewson. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 136–139. How purchasing executive should apply fundamentals of forecasting.

Reduced Force, Operating with. Operating a Factory with a Reduced Force, John C. Lease. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 533–535, 3 figs. Describes how factory was profitably operated at 30 per cent capacity.

Sales Organization. Sales Organization and Methods, Willard E. Freeland. Taylor Soc. Bul., vol. 6, no. 6, Dec. 1921, pp. 244–251 and (discussion) pp. 251–254. Second report of committee on sales questionnaire, purpose of which was to obtain information about form of organization of sales departments, extent to which engineering phases were recognized and scientific planning and scheduling attempted, and methods of control of important portions of work of distribution organization.

Standard Lot Quantities. Establishing Profitable Standard Lot Quantities, J. A. Bennie. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 167–169, 2 figs. How to determine order points for stock parts.

Time Study. See TIME STUDY.

INDUSTRIAL ORGANIZATION

Administration Problems. Works Organization, T. E. Pattinson. Eng. Production, vol. 4, nos. 70 and 71, Feb. 2 and 9, 1922, pp. 101–104 and 124–127, 18 figs. Deals mainly with problems which have been encountered in administration of a large works organization. Paper presented before Instn. Production Engrs. See also discussion in same journal, no. 72, Feb. 16, 1922, pp. 149–152.

Fundamentals. The Body, Soul and Spirit of Organization, B. A. Franklin. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 143–145. Discusses fundamentals underlying organizing for accomplishment.

Profit Margins, Reestablishing. Reestablishing the Profit Margins in the Edison Industries, Alfred Stuart Myers. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 131–135. Describes executive policies that successfully met problems of depression.

Profits, Stabilizing. Stabilizing the Profits of the Small Factory, Ernest Cordeal. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 146–149. Author points out necessity of constant attention to raw-material market, probable demand for product and stability of wage scales, and shows how useless any cost system may become unless it is intelligently followed up.

INDUSTRIAL RELATIONS

Antagonism of Capital and Labor. The Inevitable Antagonism Between Employers and Employees, C. E. Knoeppel. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 143–148. Writer maintains that interests of capital and labor, instead of being mutual, are absolutely antagonistic; as factors in industrial life they are irreconcilable; they have every reason for staying apart; they have always fought, are fighting now, and will continue to fight. Discusses possibilities of future development of a mutuality of interests.

INTERNAL-COMBUSTION ENGINES

Castings for. Some Castings for Internal Combustion Engines, Ben Shaw and James Edgar. Foundry Trade Jl., vol. 25, no. 285, Feb. 2, 1922, pp. 83–87, 26 figs. Deals with patternmaking for crankcases, drawing board, and core-boxes.

Combustion in. Study of Combustion of Liquid Fuels in Internal-Combustion Engines, with Special Regard to Fuel and Exhaust-Gas Analysis (Beiträge zur Kenntnis der Verbrennung flüssiger Brennstoffe in Motoren, unter besonderer Berücksichtigung der Brennstoff und Abgasuntersuchung), E. Terres Fritz Wehrmann and L. Lueg. Zeit. für Elektrochemie, vol. 27, no. 17–18 and 19–20, 1921, Sept. 1 and Oct. 1, pp. 379–393 and 423–441, 33 figs. Results of tests carried out on a 4-cylinder 40-hp. Benz engine.

Fuels, Effect of. Effect of Different Fuels on the Operation of Internal-Combustion Engines (L'influence de l'emploi de combustibles differents sur le fonctionnement des moteurs à combustion interne), Henri Petit. Technique Automobile et Aerienne, vol. 12, nos. 113, 114 and 115, 1921, pp. 50–62, 72–87 and 97–115, 33 figs. No. 113: Results of experiments to determine power and efficiency of engine, energy contained in given fuel mixed with air; losses; proper conditions of combustion of various fuels, their calorific power; etc. No. 114; Relation between explosion and ignition temperatures; use of inert gases; maximum specific volume; etc. No. 115: Distribution of heat; starting engine; distribution of fuel in cylinders; volumetric efficiency; variable pressure engines, overcharged engines, and others. Gives numerous tables.

Hot-Bulb Marine. Internal Combustion Engine, J. J. Fasola. Inst. Mar. Engrs. Trans., vol. 33, Jan. 1922, pp. 583–628, (includes discussion) 10 figs. Fundamentals and other particulars relating to a modern hot-bulb marine engine.

[See also AIRPLANE ENGINES; AUTOMOBILE ENGINES; CARBURETORS; DIESEL ENGINES; GAS ENGINES; HEAVY-OIL ENGINES; OIL ENGINES.]

IRON, PIG

Desulphurization of. The Desulphurization of Pig Iron and Steel (Zur Frage der Entschwefelung von Roheisen und Stahl), Bruno Simmersbach. Chemiker-Zeitung, vol. 46, no. 8, Jan. 19, 1922, pp. 65–68. Notes on origin of sulphur in pig iron and steel and suggestions for its removal.

L

LABOR TURNOVER

Absenteeism. Absenteeism: a Quanitative Study, J. D. Hackett. Management Eng., vol. 2, no. 2, Feb. 1922, pp. 85–90. Factors from experience on causes, occurence, and duration of absenteeism and condition of absentees.

Unavoidable, Elements of. Elements of Unavoidable Labor Turnover, A. L. DeLeeuw. Management Eng., vol. 2, no. 3, Mar. 1922, pp. 137–142, 5 figs. It is maintained that labor turnover of whatever kind provides measure of management efficiency because its cost is an overhead expense.

LABORATORIES

Foundry. Keighley Laboratories, Limited. Foundry Trade Jl., vol. 25, no. 285, Feb. 2, 1922, pp. 75–80, 14 figs. Traces origin of laboratory and describes its equipment and recent research work carried out in connection with internal chill in gray-iron castings.

Laboratory for Malleable Iron Foundry. Iron Age, vol. 109, no. 10, Mar. 9, 1922, pp. 643–644, 3 figs. Equipment for running carbon, sulphur and manganese determinations facilitates control of product. Getting rid of heavy gases.

Industrial. Research Laboratories in Industrial Establishments of the United States. Nat. Research Council Bul., vol. 3, no. 16, Dec. 1921, 135 pp. List of laboratories arranged by firm names, with a subject classification, giving particulars as to research staff, research work and equipment in each case.

Originally compiled by Alfred D. Flinn, revised and enlarged by Ruth Cobb.

LATHES

Bed Guards. Durability in Machine Tools, P. V. Vernon. Eng. Production, vol. 4, no. 72, Feb. 16, 1922, pp. 153-154, 3 figs. Describes Herbert automatic lathe fitted with bed guards, introduced in 1910, and new model no. 11 hexagon turret lathe, embodying similar protective devices.

Fay, Machining on. Cutting the Production Cost of a Difficult Part, H. A. Loudon. Am. Mach., vol. 56, no. 10, Mar. 9, 1922, pp. 369-370, 6 figs. Describes machining of one of its own parts, the cam drum worm, by the standard Fay lathe.

Turret. A New Hexagon Turret Lathe. Engineer, vol. 133, no. 3450, Feb. 10, 1922, p. 160, 1 fig. Claimed to be an entirely new type. One of chief features is fact that scraped bed slides are completely covered by cast iron guards; another feature is manner in which all possible points of danger are guarded.

Motor-car Engine Production Work on Turret Lathes. Machy. (Lond.), vol. 19, no. 489, Feb. 9, 1922, pp. 570-573, 8 figs. Time-saving and cost-reducing methods for engine department of a motor-car plant.

LIGHTHOUSES

Aerial. Aerial Lighthouses. Aerial Age, vol. 14, no. 24, Feb. 20, 1922, pp. 564-565 and 561, 2 figs. Describes lighthouse being erected at Dijon in order to provide suitable guiding light for aerial routes between Paris and Algiers, Italy and Switzerland. Made by optical firm of Barbier, Bernard and Turenne, Paris.

LIGHTING

Artificial Daylight. Recent Improvements in the Sheringham Daylight, S. H. Groom. Illuminating Engr., vol. 14, no. 9, Nov. 1921, pp. 215-218, 4 figs. Principles upon which Sheringham daylight is based and recent improvements made.

Factory. Better Lighting Increases Production, Ward Harrison, O. F. Haas and F. W. Dopke. Iron Trade Rev., vol. 70, no. 9, Mar. 2, 1922, pp. 610-612, 2 figs. Account of investigation carried out by Dover Mfg. Co., Dover, Ohio, in its plant for purpose of obtaining further practical data showing effect of good lighting on efficiency of production.

Phototechnical Calculations. Phototechnical Calculations According to the Nomographic System (Lichttechnische Berechnungen in nomographischer Behandlungsweise), L. Bloch. Elektrotechnische Zeit., vol. 43, no. 3, Jan. 19, 1922, pp. 73-77, 8 figs. It is shown that practically all of more important calculations in lighting technology can be quickly and easily carried out with aid of nomographic methods.

LIGNITE

Dried, Specific Heat of. Determination of the Specific Heat for Dried Lignite and Lignite Briquettes (Bestimmung der spezifischen Wärme für getrocknete Braunkohle und Braunkohlenbriketts), J. Baudenbacher. Braunkohle, vol. 20, no. 28, Oct. 15, 1921, pp. 433-435, 1 fig. Results of test show that behavior of lignite in the absorption of heat is different from that of anthracite. Specific heat coefficient of German water-free lignite is found to be 0.49.

LOCOMOTIVES

Cylinders. Locomotive Cylinders. Ry. Gaz., vol. 36, no. 4, Jan. 27, 1922, p. 138, 2 figs. Describes method of L. B. Billinton, of Lond., Brighton & South Coast Ry., and results obtained, for renewing port faces of locomotive cylinders which have become prematurely worn to scrapping limits.

Development. What is Your Locomotive Policy? G. M. Basford. Central Ry. Club official Proc., vol. 30, no. 1, Jan. 1922, pp. 1086-1105 and (discussion) 1106-1117, 10 figs. Discusses necessity of formulating a policy for next 20 or 30 years in the development of locomotives for heavy freight, fast freight, way freight, fast passenger, slower passenger, branch-line passenger and freight, yard switching, and transfer.

Diesel-Engined. Direct Drive Diesel-Air Locomotive, W. S. Burn. Eng. Rev., vol. 35, no. 7, Jan. 1922, pp. 221-225, 1 fig. Describes horizontally opposed-piston type of engine, working in conjunction with two separate crankshafts, each being connected by two driving rods at 90 deg. to a jackshaft, and thence to wheels by coupling rods; air system, water-cooling system, and other details of design. Paper read before North-East Coast Instn. of Engrs. & Shipbuilders.

German and Austrian. The Most Modern Types of Former Austrian and German Locomotives Added to the Rolling Stock of the Italian State Railways (I piu moderni tipi di locomotive Ex-Austriache ed Ex-Germaniche, entrate a far parte del parco materiale delle ferrovie dello stato). Industria, vol. 35, nos. 18, 20 and 21, Sept. 30, Oct. 31 and Nov. 15, 1921, pp. 402-407, 445-448 and 466-469, 12 figs. Sept. 30: Describes Austrian six-wheel switcher, Prairie and Mogul types, and Prussian ten-wheeler superheater type. Oct. 31: Describes eight-wheel switcher locomotive, a hump engine, and some Mastodon types. Nov. 15: List of Austrian and German locomotives added to state railway.

Mikado and 8-Wheel. Mikado Locomotive for the Greenbrier & Eastern Railroad and Eight-Wheel Type Locomotive for the Dayton-Goose Creek Railroad. Ry. & Locomotive Eng., vol. 35, no. 2, Feb. 1922, pp. 42-43, 2 figs. Describes Mikado 2-8-2, with tractive effort of 45,750 lb., and eight-wheel 4-4-0 type, with tractive effort of 13,770 lb., Built by Baldwin Locomotive works. See also Ry. Rev., vol. 70, no. 7 Feb. 18, 1922, pp. 213-214, 2 figs.

Northern Pacific Ry. Extensive Order of New Locomotives for the Northern Pacific Railway Company. Ry. & Locomotive Eng., vol. 35, no. 2, Feb. 1922, pp. 35-36, 3 figs. Describes Pacific type 4-6-2, Mikado type 2-8-2, and Mallet type 2-8-8-2, built by Am. Locomotive Co., with tractive efforts of, respectively, 41,900 lb., 57,100 lb., and 105,100 lb.

Ownership and Operation. Factors in the Business of Owning Locomotives, C. B. Peck. Ry. Age, vol. 72, no. 8, Feb. 25, 1922, pp. 471-474. Discusses coöperation between locomotive power and operating departments in designing and operating to secure economy. Paper read before Western Ry. Club.

Rebuilt. Operating Results Show Savings by Rebuilt Power, H. F. Grewe. Ry. Age, vol. 72, no. 7, Feb. 18, 1922, pp. 423-424, 2 figs. Gives locomotive data comparative mileages and expenses; operating costs.

The Passing of the Cross-Compound. Ry. Rev., vol. 70, no. 8, Feb. 25, 1922, p. 265, 2 figs. Describes conversion of a number of ten-wheel type cross-compound locomotives into simple locomotives of same type equipped with superheaters and piston valves.

Shay Geared. Shay Geared Locomotives for Mountain Roads. Ry. Mech. Engr., vol. 96, no. 2, Feb. 1922, pp. 75-76, 3 figs. 150-ton locomotive of Shay geared three-truck type with gear ratio of 1 to 2.45; for Greenbriar, Cheat & Elk Railroad. Comparison with heavy Mikado.

Speed Indicators. The Telco Locomotive Speed-Indicator and Recorder. Engineering, vol. 113, no. 2927, Feb. 3, 1922, pp. 131-133, 27 figs. Describes instrument constructed by Hasler Telegraph Works, London, having an ordinary clock movement which gives actual time and which is combined with gear producing a time record; also a distance counter, and speed-recording gear.

Steam-Turbine. The First Steam Turbine Locomotive. Ry. Mech. Engr., vol. 96, no. 2, Feb. 1922, pp. 69-70, 3 figs. Describes locomotive designed by Belluzzo, in 1908; maximum rotative speed of turbines was 2400 r.p.m. at 28 m.p.h.

Turbine Characteristics and Design of Turbo-Locomotives. Ry. Mech. Engr. vol. 96, no. 2, Feb. 1922, p. 61. Editorial discussing difficulties that must be overcome to apply the turbine to locomotives.

Zoelly Turbine Locomotive for Swiss Federal Railways. Ry. Mech. Engr., vol. 96, no. 2, Feb. 1922, p. 70. Describes new design of Dr. Zoelly, of Escher, Wyss & Co., Zurich, Switzerland. A 4-6-0 type locomotive has been converted from a standard type with usual reciprocating steam engine to turbine-driven engine. Turbine is designed for speed of 8000 r.p.m. or 48½ m.p.h.

LUBRICATING OILS

Airplane Engines. Paraffin viz. Naphthene Base Oils. Sci. Lubrication, July 1921, pp. 5-8 and 13, 4 figs. Describes tests made for purpose of deciding various questions regarding lubrication of aeronautic engines with oils from Texas, Pennsylvania, and oils compounded with graphite.

Cutting Fluids. Cutting Fluids, Eugene C. Bingham. U. S. Bur. of Standards Technologic Papers, no. 204, Dec. 20, 1921, pp. 35-76, 8 figs. Used both to cool and lubricate. When lubrication is more important, it is generally recognized that fatty oils are superior to mineral oils, though reason has never been clearly explained. Evidence appears to be that value of fatty oils is due to their residual valence or acidity which causes their adhesion to metal to be greater than is case with mineral oils. Points out that it may yet be possible to synthesize an oil which has all of virtues of lard oil without its defects.

Dilution. Dilution of Crank Case Oil, C. M. Larson. Sci. Lubrication, Oct. 1921, pp. 13-15, 2 figs. Dilution of motor oils and possible means of preventing or correcting this condition in immediate future. Suggests that new instruments recently developed for detecting dilution be used by motorists, and that motors be drained as soon as instruments show mixture in crankcase has reached dangerous condition.

Light Force-Feed. Endurance Tests of Force Feed Oils, J. G. O'Neill. Sci. Lubrication, Aug. 1921, pp. 5-10, 10 figs. Results obtained from endurance test of oils to ascertain service obtained from light force-feed lubricating oils when used in a force-feed lubrication system. Character of changes which take place in these oils under severe service conditions. Reprinted from Jl. Am. Soc. Naval Engrs., May 1921

Tests. Comparative Lubricating Engineering. Sci. Lubrication, Oct. 1921, pp. 20-22. Describes tests made to bring out relative lubricating qualities of various oils and tests made to determine most satisfactory and efficient lubricant for elevator worm gears.

Viscosity. Lubrication and Lubricants, Leonard Archbutt. Soc. Chem. Industry Jl., vol. 40, no. 24, Dec. 31, 1921, pp. 287T-293T. Discusses theory of viscous lubrication; measurement and expression of vicosity; effect of pressure on viscosity and density; solid contact friction; oiliness and its measurement; thickness of lubricating films; solid lubricants.

How Variation of Temperature Affects Viscosity of Lubricating Oils, W. F. Osborne. Power, vol. 55, no. 11, Mar. 14, 1922, pp. 420-421, 1 fig. Includes chart showing how viscosities vary with temperature.

LUBRICATION

Lubrication Engineering. The Status of Lubrication Engineering, W. H. Bailey. Sci. Lubrication, Oct. 1921, pp. 5-7. Discusses conservation of lubricants and liquid fuels, and basis from which these commodities are derived. Outlines purposes of Am. Soc. Lubricating Engrs.

Thickness of Oil Films in Bearings. The Thickness and Resistance of Oil Films in High Speed Bearings, Gerald Stoney, R. O. Boswall and J. Massey. Engineering, vol. 113, no. 2931, Mar. 3, 1922, pp. 249-250, 7 figs. Account of experimental investigation carried out during 1921 at College of Technology, Manchester, England for purpose of determining actual thickness of oil film or of discovering in what way this thickness changes with variations in load, rubbing speed and viscosity.

M

MACHINE GUNS

Patents for Inventions. Ordnance and Machine Guns. Abridgments of Specifications, Period—A.D 1909-15, class 92 (ii), 1921, 355 pp. Patents for inventions.

MACHINE SHOPS

British. A Bradford Engineering Works. Engineer, vol. 133, no. 3452, Feb. 24, 1922, pp. 210-212, 10 figs. partly on p. 214. Describes works of Cole, Marchent and Morley for manufacture of steam engines, Diesel engines, etc.

British Machine Tool Works. British Machine Tool Eng., vol. 2, no. 13, Jan.-Feb. 1922, pp. 428-431, 3 figs. Describes works of Kendall & Gent, Ltd., Gorton, Manchester.

Famous British Works. Eng. Production, vol. 4, no. 71, Feb. 9, 1922, pp. 122-123, 5 figs. Describes works of Greenwood & Batley, Ltd., Leeds for construction of metal-making, hydraulic, electric, turbine and textile machinery.

Famous British Works. Eng. Production, vol. 4, no. 73, Feb. 23, 1922, pp. 170-172, 6 figs. Describes works of Worthington-Simpson, Ltd., Newark-on-Trent, for manufacture of all types of pumping machinery.

Famous British Works. Eng. Production, vol. 4, no. 74, Mar. 2, 1922, pp. 194-196, 6 figs. Describes works of Blackstone & Co., Rutland Engineering Works, Stamford, for manufacture of oil engines and agricultural machinery.

MACHINE TOOLS

Anti-Slip Devices. Anti-Slip Devices Save Time and Money, Fred Horner. Can. Machy., vol 27, no. 8, Feb. 23, 1922, pp. 19-20, 8 figs. Positive stops to prevent sliding; serration on tool face; anti-slip thrust screws; etc.

Electric Drive for Reversing. Electric Drive for Reversing Machine Tools, A. L. Harvey. Am. Mach., vol. 56, no. 10, Mar. 9, 1922, pp. 371-373. Notes on reversing mechanisms; dynamic braking and "plugging;" power consumed in reversing; effect of reversing on production; variation in power requirements.

MALLEABLE CASTINGS

Reactions in Malleablizing. Studies Reactions in Malleablizing, Arthur Phillips and E. S. Davenport. Foundry, vol. 50, no. 5, Mar. 1, 1922, pp. 185-194, 49 figs. Describes results of experiments showing effect of different temperatures and length of anneal.

MARINE BOILERS

Dyson. The Dyson Boiler, H. G. Cooper. Am. Soc. Naval Engrs. Jl., vol. 34, no. 1, Feb. 1922, pp. 33-55, 16 figs. Describes boiler and tests made at Fuel Oil Testing Plant of Phila. Navy Yard. It is believed that this boiler would prove a particularly satisfactory steam generator for capital ships.

METALLOGRAPHY

Etching. New Etching Method Develops Figures Ascribed to the Influence of Force, Ad. Fry. Forging & Treating, vol. 8, no. 2, Feb. 1922, pp. 99-104, 19 figs. Discusses nature and procedure of etching, and origin and nature of force influence figures. Translated from Stahl und Eisen, Aug. 11, 1921.

METALS

Calorizing. Calorizing, Arthur V. Farr. Engrs., Soc. West. Pa. Proc., vol. 37, no. 6, July 1921, pp. 331-340 and (discussion) pp. 341-343. Description of calorizing based upon standard methods as practiced under General Elec. Co.'s patent rights.

Colloidal State. Colloidal State in Metals and Alloys—III and IV, Jerome Alexander. Chem. & Met. Eng., vol. 26, nos. 4 and 5, Jan. 25 and Feb. 1, 1922, pp. 170-172 and 201-207, 11 figs. Jan. 25: White metal and brass. Feb. 1: Iron and Steel. Paper read before Am. Inst. Min. & Met. Engrs.

Failure Due to Internal Stress. The Failure of Metals Through the Action of Internal Stress Irregularities with Special Reference to Tool Steels, J. Neill Greenwood. Faraday Soc. Trans., vol. 17, part 1, no. 49, Dec. 1921, pp. 123-138, 6 figs. Investigation of basic reasons for failures and measures for minimizing their occurences. Bibliography.

Heat Treatment. Heat Treatment of Metals (Les traitements thermiques des métaux), R. Panaud. Outillage, vol. 243, no. 3, Jan. 21, 1922, pp. 73-75, 13 figs. Tempering baths; temperature and methods of tempering and effect on steel and other metals.

Tests for Automotive Industries. Correlation Between Metallurgical and Service Tests, Walter Rosenhain. Automotive Industries, vol. 46, no. 10, Mar. 9, 1922, pp. 566-568. Discusses need for greater coöperation between metallurgical and automotive engineers with a view to developing tests, result of which can be used with greater certainty of success in selecting most suitable metals for various purposes.

Thermal Expansion. Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel, and Aluminum, Wilmer H. Souder and Peter Hidnert. U. S. Bur.

of Standards Sci. Papers, no. 426, Dec. 17, 1921, pp. 497–519, 10 figs. Data on thermal expansion of 29 samples are presented, all of which, except stainless steel, were examined from room temperature to about 600 deg. cent. Samples of stainless steel were heated from room temperature to 900 deg. cent.

METRIC SYSTEM

Russia. The Metric System in Russia (Le système métrique en Russie), Léopold Reverchon. Nature, no. 2491, Dec. 31, 1922, pp. 427–428. Discusses degrees adopting metric system and gives table of equivalents.

MILLING CUTTERS

Top and Side Rake. Formed Milling Cutters and Hobs with Top and Side Rake, Harry E. Harris. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 527–528, 2 figs. Summarizes chief advantages of providing a hook on hob and cutter teeth.

MILLING MACHINES

Locomotive Bar Frames. Profile Milling Locomotive Bar Frames. Machy. (Lond.), vol. 19, no. 490, Feb. 16, 1922, pp. 600–601, 5 figs. Describes machine developed by Ernst Schiess, of Düsseldorf, with object of completely machining locomotive bar frames of about 4 in. in thickness from solid slab as furnished by rolling mills.

MOLDING MACHINES

Automobile Foundries. Modern Molding Machines in Foundries of Automobile Plants (Neuzeitliche Formmaschinen in Giessereien der Automobil-Industrie), Oskar Redwitz. Motorwagen, vol. 25, no. 3, Jan. 31, 1922, pp. 48–53, 26 figs. Describes molding machines constructed by the Richard Kindler Foundry Machine Works, Kirchheim-Teck, Germany, for automobile industry.

Hydraulic Jar-Ramming. French Molding Methods Are Rapid. Foundry, vol. 50, no. 4, Feb. 15, 1922, pp. 153–155, 7 figs. Describes new jar-ramming machine employing hydraulic principle.

Roll-Over. A German Roll-Over Molding Machine (Eine deutsche Umrollformmaschine), U. Lohse. Stahl u. Eisen, vol. 41, no. 52, Dec. 29, 1921, pp. 1889–1892, 7 figs. Notes on development by Pridmore and Tabor, followed by detailed description of design and manipulation of new machine by firm of Alfred Gutmann, Altona-Ottensen, use of which is especially recommended for molds of small and medium size, but of considerable height.

MOLDING METHODS

Pattern and Molding Plates. The Production of Pattern and Molding Plates (Aus der Praxis der Modell- und Formplattenherstellung), Ferd. Brobeck. Zeit. für die gesamte Giessereipraxis, vol. 43, nos. 1 and 2, Jan. 7 and 14, 1922, pp. 1–3 and 19–21, 26 figs. Purpose and use of patterns and molding plates; production of metal patterns. Includes schematic table showing working method of different types of molding machines in separating of pattern and sand.

Roll Methods. Diverse Methods of Roll Molding, R. H. Palmer. Foundry, vol. 50, no. 4, Feb. 15, 1922, pp. 159–163, 16 figs. Rolls cast in solid chills swung on supporting columns; some poured on end and others on side; various methods of gating are described.

MONEL METAL

Uses and Properties. Some Typical Uses and Properties of "Monel" Metal, Edwin S. Wheeler and Robert J. McKay. Engrs.' Soc. West Pa. Proc., vol. 37, no. 6, July 1921, pp. 311–324 and (discussion) pp. 325–330. Deals with occurrence and metallurgy; typical properties; typical and special uses.

MOTION PICTURES

Wasteful Methods, Showing. Films Reduce Losses from Scrap, Winthrop G. Hall. Iron Trade Rev., vol. 70, no. 10, Mar. 9, 1922, pp. 681–682. Moving pictures showing wasteful methods of employees prove effective means of curbing carelessness in handling materials in wire plant. Factors to be considered in filming industrial scenes. (Abstract.) Paper read before Worcester (Mass.) section of Am. Soc.Mech.Engrs.

MOTION STUDY

See POLISHING, Metal; TIME STUDY, Motion Study and.

MOTOR BUSES

Delaware, Maryland and D. C. The Bus in Northern Dixie. Elec. Ry. Jl., (Bus Transportation), vol. 59, no. 6, Feb. 11, 1922, pp. 93–102, 3 figs. Deals with conditions surrounding highway motor-bus operation and regulations prescribed in Delaware, Maryland and District of Columbia.

Eight-Wheel. Eight Wheels Improve Riding Qualities. Elec. Ry. Jl. (Bus Transportation), vol. 59, no. 6, Feb. 11, 1922, pp. 121 and 123, 4 figs. Describes new Californian bus. Has double-axle construction at both front and rear so that virtually it has two trucks. Front four wheels steer in unison; drive to four rear wheels is through two sets of worm and gear axles.

Local Railway Service. A Gasoline Motor Bus for Local Railway Needs (Automotrice à essence et à deux essieux pour chemins de fer d'intérêt local), G. Tartary. Génie Civil, vol. 80, no. 5, Feb. 4, 1922, p. 115, 1 fig. Describes new car seating 16 passengers, put in service by Deux-Sevres Tramway Co.

Snow Removal for. Fighting Snow on Suburban Routes. Elec. Ry. Jl. (Bus Transportation), vol. 59, no. 6, Feb. 11, 1922, pp. 103–104, 4 figs. Use of passenger buses with plows attached, for clearing snow.

Transportation. Putting the Motor Bus and Trolley Together to Build Service, H. W. Grant. Elec. Ry. Jl. (Bus Transportation Section), vol. 59, no. 2, Jan. 14, 1922, pp. 1–4, 7 figs. Describes linking up of interurban by means of motor buses in Puget Sound district in Washington.

MOTOR SLEDS

Design. The Problem of Motor Sleds (Das Problem des Motorschlittens), H. Schiebler. Motorwagen, vol. 24, nos. 35 and 36, Dec. 20 and 31, 1921, pp. 767–775 and 787–795, 42 figs. Desiderata for structural requirements, technical evaluation of snow, that is, its resistivity and friction coefficients under varying conditions. Description of electric-motor-driven trial sled, and results of tests.

MOTOR TRUCKS

Double-Reduction Axles. New Double Reduction Truck Axle. Automotive Industries, vol. 46, no. 8, Feb. 23, 1922, pp. 458–459, 2 figs. Describes new double-reduction design by John Thomson Press & Mfg. Co.

Steam. 5-Ton Steam Wagon with Uniflow Engine. Engineering, vol. 113, no. 2928, Feb. 10, 1922, pp. 162–163, 23 figs. partly on supp. plate. Describes tipping model embodying the Atkinson uniflow engine and auxiliary tipping engine, which can lift body and bring it back into position in two minutes.

MOTORCYCLES

Olympia Exhibition. The Motor Cycle Show. Automobile Engr., vol. 12, no. 159, Jan. 1922, pp. 13–19, 24 figs. Discusses machines at exhibition held at Olympia, Nov. 28 to Dec. 3.

O

OFFICE MANAGEMENT

Cutting Clerical Cost. Cutting the Clerical Cost, Henry Anson Piper. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 119–124, 7 figs. Planning procedure for plant offices in large organizations.

Scientific. The Application of the Principles of Scientific Management to the Office, William Henry Leffingwell. Bul. of Taylor Soc., vol. 7, no. 1, Feb. 1922, pp. 2–24 and (discussion) 24–26, 13 figs. Discusses planning and control, standardization, investigation and research, inspection and maintenance of quality, scientific office arrangement, etc.

OIL ENGINES

Scott-Still. A New Development in Marine Propulsion. Engineering, vol. 113, no. 2928, Feb. 10, 1922, pp. 177–178. Includes report by H. Riall Sankey on series of trials on Scott-Still engines for a Holt vessel, and gives details of engines.

Still Engine Developments. Engineer, vol. 133, nos. 3451 and 3452, Feb. 17 and 24, 1922, pp. 180–182 and 204–207, 20 figs. Includes full test of report by H. Riall Sankey on tests carried out on Still engine; and review of paper read by Archibald Rennie before Instn. of Engrs. & Shipbuilders in Scotland, giving particulars of the Scott-Still experimental unit.

OIL FUEL

Competition with Coal. Why Fuel Oil Must Continue to Compete with Coal, E. J. Billings. Power, vol. 55, no. 11, Mar. 14, 1922, pp. 417–419. Points out that fair comparison of fuel oil with coal cannot be made on basis of B.t.u. alone. Allowance must be made for higher efficiency and reduced operating expenses.

Gasification System. A System for Complete Fuel Gasification. Automotive Industries, vol. 46, no. 9, Mar. 2, 1922, pp. 509–510, 2 figs. Involves use of device for mechanical agitation of mixture, retort for heating entire charge above vaporization temperature of least volatile elements, and means for admixture of small quantities of exhaust gas to prevent detonation.

Vaporization. A Discussion of Present Methods of Fuel Vaporization, N. Julien Thompson. Automotive Industries, vol. 46, no. 9, Mar. 2, 1922, pp. 515–517, 2 figs. Preparation of fuel-air mixtures for combustion prior to admission to cylinder.

OILS

Linseed, Vanadium Driers for. Vanadium Compounds as Driers for Linseed Oil, F. H. Rhodes and K. S. Chen. Jl. Indus. & Eng. Chem., vol 14, no. 3, Mar. 1922, pp. 222–224, 2 figs. Describes vanadium driers possessing certain advantages not shown by lead, manganese, or cobalt driers in common use, which should prove very satisfactory in preparation of certain types of paint and varnish.

OPEN-HEARTH FURNACES

Design. Open-Hearth Furnace Design, A. D. Williams. Iron Age, vol. 109, no. 9, Mar. 2, 1922, pp. 577–579, 3 figs. Calculations for hearth area, depth of metal, incline of parts and velocity of gases.

OSCILLOSCOPE

Operation. The Oscilloscope. Motor Transport, vol. 34, no. 883, Jan. 30, 1922, pp. 123–124, 3 figs. Describes invention by means of which it is possible to examine any fast-running machinery either as if it were running at 1/100 of its actual speed, or, at will, as if it were stationary.

OXY-ACETYLENE CUTTING

Under Water. Submarine Cutting Torch Under Water, Robert G. Skerrett. Iron Age, vol. 109, no. 10, Mar. 9, 1922, pp. 637–639, 5 figs. Broken siphon pipe burned off by electric torch under 50 ft. of water. Discusses American progress in submerged metal cutting.

OXY-ACETYLENE WELDING

Blowpipe Investigation. An Investigation of Oxy-acetylene Welding and Cutting Blowpipe, with Especial Reference to Their Design, Safety, and Economy in Operation, Robert S. Johnston. U. S. Bur. of Standards Technologic Papers, no. 200, Dec. 28, 1921, pp. 3–108, 71 figs. Apparatus from 14 of most prominent manufacturers were tested under standardized conditions. None of commercial cutting blowpipes procurable appear to be designed according to definite, theory and none are efficient in cutting metal of all thicknesses, none were correctly designed, nor free from flash-back phenomena. With properly designed welding blowpipe, it is believed that satisfactory fusion welds may be made.

Explosions, Prevention of. Dangers from the Use of Acetylene Gas and in Oxy-Acetylene Welding. Eng. & Indus. Management, vol. 7, no. 7, Feb. 16, 1922, pp. 192–193. Precautionary methods are given which should be observed by all employed in welding work. Deals with explosions in generator houses; high-pressure systems; and care of cylinders. Based on official memorandum issued by Factory Department of British Home Office.

P

PAPER MANUFACTURE

Load Regulator for Pulp Grinders. Automatic Load Regulator for Motor-Driven Pulp Grinders, W. H. Artz. Chem. & Met. Eng., vol. 26, no. 8, Feb. 22, 1922, pp. 367–369, 4 figs. Describes apparatus, its operation, and advantages.

Process and Machinery. Paper Making and Paper Making Machinery, Ellsworth Sheldon. Am. Mach., vol. 56, no. 9, Mar. 2, 1922, pp. 317–319, 6 figs. Forest is principal source of raw material. Process is continuous from grinding wood to winding finished sheet of paper.

Southern Pine Refuse. The Manufacture of Paper and By-Products from Southern Pine Refuse, Joseph H. Wallace. Worcester Polytechnic Inst. Jl., vol. 25, no. 2, Jan. 1922, pp. 65–79, 3 figs. Discusses manufacture of chemical fiber suitable for Kraft wrapping or book paper and test board by-product manufacture of naval stores; destructive distillation of trash; improvement of lands.

PIPING

Air-Pressure Drop Through. Air Pressure Drop Due to Small Pipe, W. A. Shmidheiser. Power Plant Eng., vol. 26, no. 4, Feb. 15, 1922, pp. 234–235, 1 fig. Describes experiment made to determine air pressure drop through $1^1/_2$-in. pipe.

PISTON RINGS

Design and Uses. The Piston Ring—Lilliputian in Size, Giant Among Parts in Technical and Commercial Importance, Morris A. Hall. Raw Material, vol. 5, no. 1, Feb. 1922, pp. 13–18, 10 figs. Discusses design, forms, and uses.

Locomotive. The "Rowan" Type of Piston Rings For Locomotives. Ry. Gaz., vol. 36, no. 4, Jan. 27, 1922, p. 137, 1 fig. Describes rings patented by William Rowan, of Belfast.

PISTON RODS

Packing for High-Pressure. Packing a Rod For 500,000 Lbs. Pressure, P. W. Bridgman. Power House, vol. 15, no. 3, Feb. 5, 1922, pp. 25–27, 4 figs. Describes principle of packing and some details of its application. Results of high-pressure experiments.

PISTONS

Manufacturing Plant. A Piston Manufacturing Plant, G. M. Ellis. Western Machy. World, vol. 13, no. 2, Feb. 1922, pp. 53–55, 7 figs. Describes plant of W. H. Jahns at Los Angeles; methods and equipment used.

PLATES

Rectangular, Bending of. The Bending of a Rectangular Plate Supported on All Sides and Subjected to a Single Load (Ueber die Biegung der allseitig unterstützten rechteckigen Platte unter Wirkung einer Einzellast), S. Timoschenko. Bauingenieur, vol. 3, no. 2, Jan. 31, 1922, pp. 51–54, 3 figs. Explains how to solve problem of deflection of rectangular plate braced on two opposite sides and supported on the two other sides.

POLISHING

Metal, Motion Study in. Motion Study in Metal Polishing, E. Farmer and R. S. Brooke. Eng. & Indus. Management, vol. 6, no. 26, Dec. 29, 1921, pp. 738–742, 3 figs. Experiment with a wattmeter on process of roughing.

POWER PLANTS

Design. Developments in Power Station Design. Engineer, vol. 133, nos. 3450 and 3552, Feb. 10 and 24, 1922, pp. 148–150, 6 figs. and 201–204, 5 figs. Feb. 10: Describes Usco air heater of Underfeed Stoker Co., and the Howden air heaters for marine work. Feb. 24: Notes on high-pressure steam turbines.

European Practice. European Practices Tend Toward Greater Economy, A. Dyckerhoff. Elec. World, vol. 79, no. 9, Mar. 4, 1922, pp. 421–424, 6 figs. Standardization of equipment and grouping of related activities. Waste-heat boilers, gas turbines, large mercury rectifiers and novel frequency changer. Shunt motors for shears. Power-factor correction.

nstructing Operators. Instructing Power-Plant Operators, J. A. MacMurchy. Power, vol. 55, no. 7, Feb. 14, 1922, pp. 260–262. Problems of making

operator familiar with equipment for which he is responsible. Methods of providing proper instructions.

PRESSES

Notching. Notching Press for Armature Plates and Segments. Engineer, vol. 133, no. 3451, Feb. 17, 1922, p. 188, 2 figs. Constructed with object of providing machine whereby armature plates or segments thereof may be notched, internally or externally, in accurate and continuous manner.

Safety Devices. Safety Devices for Power Presses. Machy. (Lond.), vol. 19, nos. 474 and 487, Oct. 27, 1921 and Jan. 26, 1922, pp. 96–99 and 523–525, 16 figs. Oct. 27: Various types of gate guards. Jan. 26: Deals with gate, stationary and sliding guards, provided for power press equipment of Cleveland Metal Products Co.'s plant, Cleveland, Ohio.

PRODUCER GAS

Analysis. Graphical Treatment of Stack Gas Analysis and of Producer Gas Analysis—II, W. Trinks. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 131–135, 8 figs. Graphical representation of producer-gas analysis. Review of graphic charts as introduced by W. Ostwald.

PULVERIZED COAL

Combustion. Combustion of Pulverized Fuel, F. P. Coffin. Combustion, vol. 6, no. 3, Mar. 1922, pp. 129–132, 1 fig. Chemistry of combustion; ash; flames; velocities of fuels; preheating air for combustion; control of furnace temperature. (Excerpt.)

Evaporative Tests. Pulverized Coal (Le combustible pulvérisé), Charles Baron. Mémoires et Compte Rendue des Travaux de la Société des Ingénieurs Civils de France, vol. 74, no. 7–8–9, July-Sept. 1921, pp. 403–411, 1 fig. Details of evaporation tests carried out at various plants to show efficiency of powdered coal burning.

PUMPING ENGINES

Vertical Triple-Expansion. The Vertical Triple-Expansion Pumping Engine, L. A. Quayle and F. H. Brown. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 155–161 and (discussion) pp. 161 and 176, 5 figs. Study of pumping-engine installations at Cleveland, Ohio, during past 65 years. New record performance at Division Ave. pumping station.

PUMPS, CENTRIFUGAL

Sugar Industry. Centrifugal Pumps in Sugar Processes, Irwin McNiece. Sugar, vol. 24, no. 2, Feb. 1922, pp. 92–93. Discusses some salient pumping problems, and what requirements of the units must be to obtain maximum service. From Sugar Central and Planters' News.

Water Leakage. On the Leakage of Water through the Clearance Rings in a Centrifugal Pump, Otogorô Miyagi. Technology Reports of Tôhoku Imperial University, vol. 2, no. 3, 1921, pp. 1–16, 3 figs. Notes on pressure difference at clearance rings; quantity of leakage; volumetric efficiency; loss of head due to leakage. Numerical example is given.

PYROMETERS

Maintenance. Some of the Difficulties Experienced in Maintaining a Pyrometer Installation in a Works, Robert S. Whipple. Ceramic Soc. Trans., vol. 21, Part 1, Session 1921–22, pp. 1–23, 7 figs. Chief difficulties experienced with pyrometers and methods by which they can be overcome or avoided. Same article in French, pp. 24–43.

R

RADIODYNAMICS

Control of Automotive Devices. Radio Control, H. H. Germond and W. P. Flynn. Wisconsin Engr., vol. 26, no. 5, Feb. 1922, p. 87, 1 fig. Discusses development of radiodynamics and describes a radio-controlled cart.

RAILLESS TRACTION

Rail vs. Trackless Transportation Versus Rail Transportation, Karl A. Simmon. Elec. Ry. Jl., vol. 59, no. 6, Feb. 11, 1922, pp. 233–236, 2 figs. Advantages and disadvantages of trolley, auto bus, and trackless trolley. Draws definite conclusions as to field for which each type of vehicle is most suitable.

RAILS

Corrugation. Formulas for Wave Lengths of Corrugations and Axis Diameters (Formeln für Riffellängen und Achsendurchmesser), Emil Madsen. Verkehrstechnik, vol. 38, no. 35, Dec. 15, 1921, pp. 543–546, 2 figs. Results of investigation show that a proper axle diameter is of greatest importance in overcoming corrugation, causes for which are enumerated.

Failures. French Investigation of Rail Failures Charles Fremont. Iron Age, vol. 109, no. 8, Feb. 23, 1922, pp. 523–524, 8 figs. Causes of increasing number. Effect of exfoliation. Rapid corrosion of rails. Segregation and poor-quality metal. Translated from Génie Civil, Nov. 19, 1921.

Heads, Conditions Affecting. Conditions Which Affect the Head of the Rail, James E. Howard. New York R. R. Club Official Proc., vol. 32, no. 3, Jan. 20, 1922, pp. 6611–6619 and (discussion) 6619–6625. Discusses strains in rails due to cooling; formation of cracks; rail tests; rail failures; etc.

Internal Fracture. The Presence of Internal Fractures in Steel Rails and Their Relation to the Behavior of the Material under Service Stresses, Henry S. Rawdon. Faraday Soc. Trans., vol. 17, part 1, no. 49, Dec. 1921, pp. 110–116, 7 figs. Discusses discontinuities or internal fractures in some types of steel rails and in other wrought-steel products, evidently serving as "nucleus" or starting point from which larger defects, termed transverse fissures, grow, under stress conditions to which rails are subjected in pratice.

Loads, Action of. Action of Rolling Loads on Rails (Étude de l'action des charges roulantes sur les rails), S. Timochenko. Le Génie Civil, vol. 79, no. 26, Dec. 24, 1921, pp. 555–556. Assumes the rail as a bar of infinite length on a continuous elastic base, and develops formulas.

RAILWAY CONSTRUCTION

Reinforced Concrete, Use of. On the Question of Reinforced Concrete (Holland), C. Leemans. Int. Ry. Assn. Bul., vol. 4, no. 2, Feb. 1922, pp. 347–358, 16 figs. Use of ordinary concrete and reinforced concrete on state railways of Java and Sumatra.

RAILWAY ELECTRIFICATION

Chile. Electrification of the Chilean State Railways. Ry. Rev., vol. 70, no. 6, Feb. 11, 1922, pp. 185–188, 5 figs. Application of hydroelectric power; details of electrification; direct current system considered best suited to conditions.

Direct Current. Railway Electrification with Direct Current (Jernbanernes elektrificering med likeström), C. Mohr. Elektroteknisk Tidsskrift, vol. 35, nos. 4, 5 and 6, Feb. 5, 15 and 25, 1922, pp. 23–26, 32–36 and 43–45, 9 figs. Notes on adoption of direct current for electrification of railway section between Kristiana and Trondhjems.

England. London, Brighton & South Coast Railway Electrification, Philip Dawson. Ry. Gaz., vol. 36, no. 6, Feb. 10, 1922, pp. 209–211, 1 fig. Report on proposed substitution of electric for steam operation of suburban, local and main-line passenger and freight services. (Abstract.)

France. The Foremost French Railway Electrification Project, G. de La Rochette. Ry. Rev., vol. 70, no. 5, Feb. 4, 1922, pp. 148–152, 6 figs. Midi Railway is developing water power for local industries and operation of 1850 miles of line. Will generate 396,000 hp. in six big hydroelectric centers.

Improvements Due to. Electrification and Its Relation to Steam Railroads, N. W. Storer. St. Louis Ry. Club Official Proc., vol. 26, no. 9, Jan. 13, 1922, pp. 188–197 and (discussion) 197–208. Discusses improvements due to electrification, and electric locomotives.

Switzerland. The Electrification of the Gotthard Line Between Lucerne and Chiasso (Die Elektrisierung der Gotthardstrecke Luzern-Chiasso der Schweizerischen Bundesbahnen), K. Sachs. Elektrotechnische Zeit., vol. 43, nos. 1, 2, 3, 4, 5 and 6, Jan. 5, 12, 19, 26, Feb. 2 and 9, 1922, pp. 1–7, 47–52, 78–85, 114–120, 143–148 and 180–186, 75 figs. Deals with power supply and distribution, power stations, feeder systems, overhead lines, and locomotives.

RAILWAY MAINTENANCE

Ditching Machines. Railway Ditching Machines and Performance Records. Eng. News-Rec., vol. 88, no. 10, Mar. 9, 1922, pp. 390–393, 5 figs. Wing-type ditchers clear track ditches and dress slopes rapidly and cheaply. Comparative costs of hand, team and machine work.

RAILWAY MANAGEMENT

Freight Loss and Damage. Prevention of Freight Loss and Damage, Joe Marshall. Can. Ry. Club Proc., vol. 21, no. 1, Jan. 1922, pp. 19–36 and (discussion) 36–40. Discusses claim prevention, the various kinds of damages for which claims are made, etc.

RAILWAY MOTOR CARS

Converted Auto Trucks. Making Motor Rail Cars from Auto Trucks, Donald A. Hampson. Ry. Rev., vol. 70, no. 6, Feb. 11, 1922, pp. 191–192, 2 figs. Describes a two-car Reo train, built by J. B. Worchester Co., Middletown, N. Y., for Alabama road, with seating capacity of 24 in each car, and operating crew of two.

Developments. Recent Development in the Railcar Field. Automotive Industries, vol. 46, no. 10, Mar. 9, 1922, pp. 556–557, 5 figs. Describes car of Indiana Truck Corp. and that of Service Motor Truck Co. Both fitted with regular and special reverse gear-sets which make possible high-speed operation in either direction, and both employ four-wheel leading trucks with live axles running in plain bearings.

Gasoline. Operating Results with Gasoline Motor Cars. Ry. Age, vol. 72, no. 9, Mar. 4, 1922, p. 516. Describes operation of Bowen motor cars by Pittsburgh and Shawmut Company to reduce cost of maintaining passenger service.

RAILWAY OPERATION

Automatic Train Control. Automatic Train Control on the Chesapeake & Ohio Ry. During the Big Snow Storm. Ry. Rev., vol. 70, no. 8, Feb. 25, 1922, pp. 257–258. Report from Calvin W. Hendrich, of Am. Train Control Co., Baltimore, of behavior of his system of automatic train control during recent heavy snow fall.

G. R. S. Company's Auto-Manual Train Control. Ry. Age, vol. 72, no. 9, Mar. 4, 1922, pp. 521–523, 6 figs. Improvements of automatic train-control system of Gen. Ry. Signal Co., Rochester, N. Y.

Train Control Test on Raritan River. Ry. Signal Engr., vol. 15, no. 2, Feb. 1922, pp. 58–60, 2 figs. Describes automatic train control of "M-V All Weather" Train Controller Co. of Newark, N. J., and tests carried out on Central of New Jersey.

Webb Automatic Train Control Tested on the Erie. Ry. Signal Engr., vol. 15, no. 2, Feb. 1922, pp. 65–66, 2 figs. Describes nine tests made on Erie R. R., all of which were satisfactory.

Avoidable Waste. Avoidable Waste in Car and Locomotive Operation, William Elmer. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 93–97, 2 figs. Outlines procedure for determining whether engines are properly loaded and used. Includes several appendices, one of which gives method of working out most economical tonnage for loading freight engines of any division, based on actual practicable performance in everyday operation. Discusses avoidable waste in operation of cars under three heads: (1) Their utilization in hands of agents, shippers and consignees; (2) handling and dispatchment in yards and on road; and (3) repair and inspection.

RAILWAY SHOPS

Can. Pac., Montreal. A Railroad Shop Organized for Efficiency. Machy. (Lond.), vol. 19, nos. 487 and 488, Jan. 26 and Feb. 2, 1922, pp. 502–504 and 535–537, 8 figs. Describes Angus shops of Can. Pacific Ry. Co., Montreal, Canada. Jan. 26: General arrangement. Feb. 2: Designs of jigs and fixtures used; outlines some methods that have made it possible to reduce costs.

Machining Operations, Cost of. What is Wrong with the Railroad Shops? Edward K. Hammond. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 557–560. Investigation into relative costs of performing machining operations in seven representative railroad shops.

RAILWAY SIGNALING

Automatic-Block. Automatic Block Signaling, J. E. Saunders. Armour Engr., vol. 13, no. 2, Jan. 1922, pp. 71–85, 8 figs. Economy of automatic signals; manual versus automatic block; train operation by signal indication; elements of automatic block signaling.

Color-Light. Color Light Signals. Ry. Engr., vol. 43, no. 505, Feb. 1922, pp. 65–66 and 74. Report of committee on Light Signals appointed by Minister of Transport. Advocates this type of signal, a color-light type with separate lenses for each color indication.

Federal Audible Signal. The Federal Signal Company's Audible Signal. Ry. Age, vol. 72, no. 9, Mar. 4, 1922, pp. 517–518, 4 figs. Describes experiments on Boston & Albany in Mass. and New York. An audible warning sounded in conjunction with visual indication given by three-position automatic semaphore.

Locking Arrangement. Locking Arrangement for Movable Point Crossing Frogs, F. Parsons. Ry. Signal Engr., vol. 15, no. 2, Feb. 1922, pp. 63–64, 4 figs. Describes system installed on Central of Argentine which insures safety with minimum apparatus. Read before Inst. Ry. Signal Engrs.

Phase Shifter for A. C. Circuits. A Phase Shifter for Adjusting A. C. Track Circuits, W. F. Price. Ry. Signal Engr., vol. 15, no. 2, Feb. 1922, pp. 61–62, 8 figs. Discusses lag of current in wet and dry weather and describes a phase shifter which works equally well on double element vane or galvanometer relays.

Three-Position, Belgium. Weissenbruch Thee-Position Signal System as Used in Belgium, T. S. Lascelles. Ry. Signal Engr., vol. 15, no. 2, Feb. 1922, pp. 55–58, 6 figs. Four indications given, clear, caution, attention or stop. Illustrations of the various positions.

RAILWAY STATIONS

Train Indicator Time-Tables. Train Indicator Time-Tables at Railway Stations. Ry. Gaz., vol. 36, no. 5, Feb. 3, 1922, pp. 177–179, 3 figs. Describes Benn & Cronin train indicator time-table.

RAILWAY TIES

Creosoting Timber Bridges and. Creosoting Timber on the Santa Fe Railway System, A. F. Robinson. West. Soc. Engrs. Jl., vol. 27, no. 3, Mar. 1922, pp. 84–90 and (discussion) pp. 90–96. Deals with creosoting timber bridges and track ties. See also Ry. Maintenance Engr., vol. 18, no. 2, Feb. 1922, pp. 44–46, 1 fig. (Abstract.)

RAILWAY TRACK

Ballast. Report of Committee II—On Ballast. Am. Ry. Eng. Assn. Bul., vol. 23, no. 239, Sept. 1921, pp. 131–158, 6 figs. Application of ballast; ballast tools; specifications for ballast shovels.

Frogs, Reclaiming. Philadelphia & Reading Reclaims Frogs by Unique Methods. Ry. Mainetnance Engr., vol. 18, no. 1, Jan. 1922, pp. 13–14, 8 figs. Describes system which, it is claimed, is attended with very satisfactory results. Both plain and hard center equipment is repaired.

Maintenance. Track Maintenance by Contract on the Canadian Pacific Ry., H. G. Harton. Eng. News-Rec., vol. 88, no. 10, Mar. 9, 1922, pp. 399–401. Successful results of three years on 400 miles.

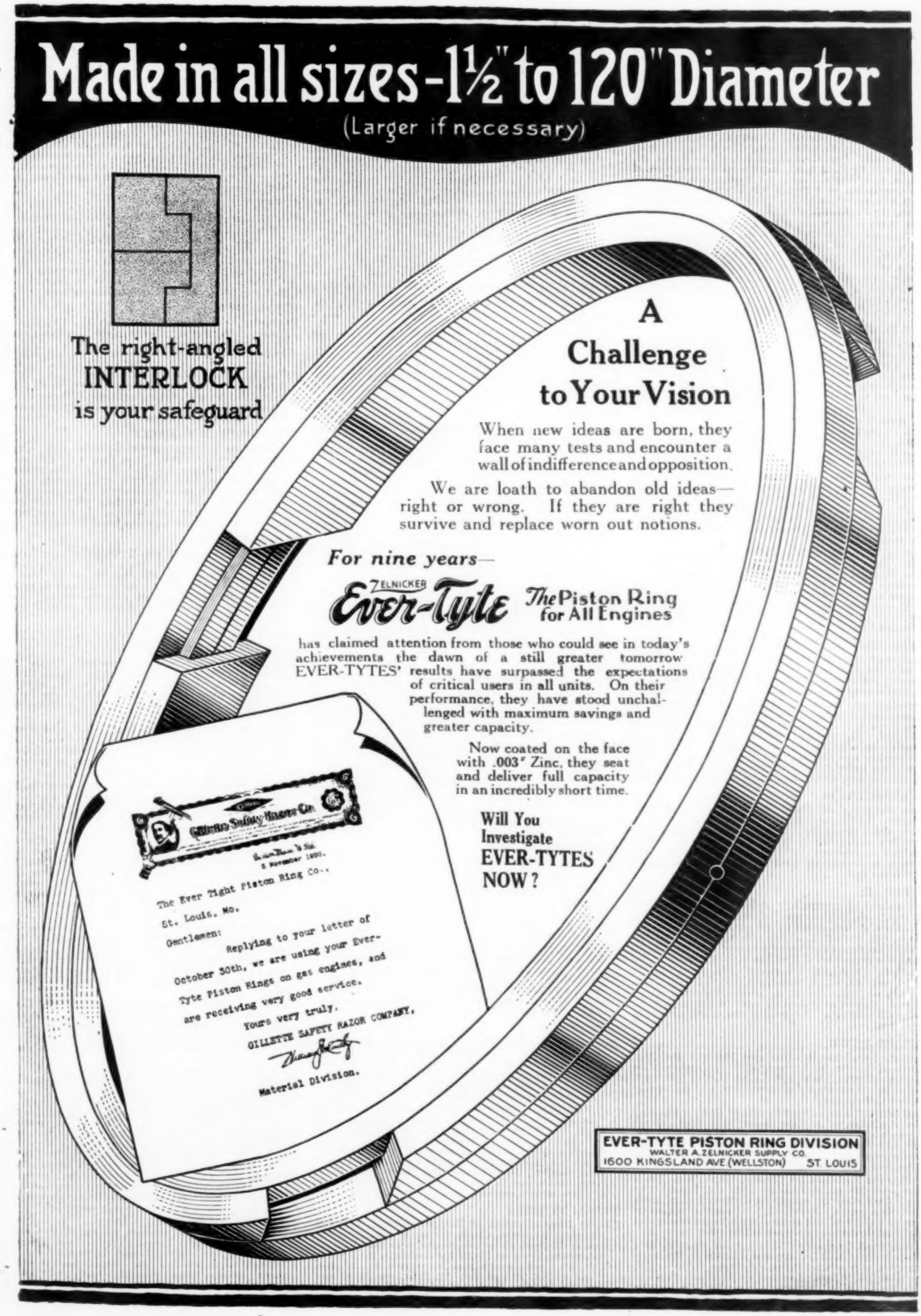
Plant Sidings. Trackage for Industrial Plants, Fred F. Hartford. Indus. Management, vol. 63, no. 3, Mar. 1922, pp. 151–154, 5 figs. Factors underlying their profitable installation.

Snow Fences. Snow Fence Design and Location. Elec. Traction, vol. 18, no. 2, Feb. 1922, pp. 144–146, 4 figs. Describes types successfully used by Chicago, North Shore and Milwaukee R. R., Rochester & Syracuse R. R., and Quebec Railway, Light, Heat & Power Co.

RAILWAYS

Cost of Transportation. On the Question of Net Cost; Rates (All Countries except America), Henry Gréard. Int. Ry. Assn. Bul., vol. 4, no. 2, Feb. 1922, pp. 331–345. Determination of net cost of carriage (passengers and goods), taking capital charges into consideration. Its relation to rates charged.

Reconstruction, France. Rebuilding Railway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Structures in Northern France, M. Pellarin. Eng. News-Rec., vol. 88, no. 10, Mar. 9, 1922, pp. 397–398, 3 figs. Unique operations employed to save as much of damaged structures as possible. Work on Nord and Est railways cited. Translated from Revue Générale des Chemins de Fer.

Russia. The Railroad Transportation Situation in Soviet Russia, E. A. MacMillan. Ry. Rev., vol. 70, no. 7, Feb. 18, 1922, pp. 218–222, 1 fig. Describes deplorable condition of present rail equipment. (Abstract.) Read before Can. Ry. Club.

South America. South American Transportation Problems (Südamerikanische Verkehrsprobleme), Colin Ross. Verkehrstechnik, vol. 39, no. 4, Jan. 27, 1922, pp. 42–47, 2 figs. Review of development of South American railways; the Argentinian railways; transportation over the Andes; the railway systems of Chile and Brazil; the central trans-continental lines; the Pacific railways.

Tests Department, New Haven, R. R. The Department of Tests of the New Haven Railroad, H. P. Hass. New England R. R. Club, Jan. 10, 1922, pp. 235–248 and (discussion) 248–272. Discusses objects of the department, which are, principally, safety and economy of operation, methods used to obtain proper product being, through use of specifications and through use of tested product sheets. Details of the five divisions of department.

REFRACTORIES

American Practice. Notes on American Practice in Refractories, W. J. Rees. Ceramic Soc. Trans., vol. 21, Part 1, Session 1921–22, pp. 69–84 and (discussion) 84–88, 19 figs. Outstanding feature of American practice is well-developed organization of plant for maximum production with minimum costs.

New. The Development of a New Refractory, A. F. Greaves-Walker. Soc. of Chem. Industry Jl., vol. 41, no. 2, Jan. 31, 1922, pp. 13T–14T. Describes work undertaken by Am. Refractories Co. in conjunction with Mellon Inst. on the production of a new refractory, and laboratory tests made.

Resistance Tests. Resistance Tests on Refractory Products under Load at Different Temperatures, V. Bodin. Ceramic Soc. Trans., vol. 21, Part 1, Session 1921–22, pp. 56–65, 8 figs. Discusses investigations to find method of determining directly crushing strength at different temperatures, and their results. In French, pp. 44–55.

Thermal Conductivity. On the Determination of the Thermal Conductivity, Specific Heat, Density and Thermal Expansion of Different Rocks and Refractory Materials, Yoshiaki Tadokoro. Tohoku Imperial University Sci. Reports, vol. 10, no. 5, Dec. 1921, pp. 339–410, 42 figs. partly on supp. plates. Account of investigation begun four years ago in research laboratory of Imperial Steel Works, Yawata.

REFRIGERATING PLANTS

Condenser Cooling-Water Diagram. Cooling Water for Ammonia Condenser, Alex H. Luedicke. Power, vol. 55, no. 8, Feb. 21, 1922, p. 302, 1 fig. Explains easy way to find amount of water required.

Corrosion in Systems. Control of Corrosion in Refrigerating Systems, F. N. Speller. A.S.R.E. Jl., vol. 8, no. 3, Nov. 1921, pp. 216–221 and (discussion) 221–224. Reviews what has been done and discusses possible application of these principles. Methods of protection are divided into two classes, viz.: by rendering water slightly alkaline, usually done by use of lime; and by eliminating free oxygen from solution.

REFRIGERATION

Brine Freezing of Fish. Brine Freezing of Fish, Harden F. Taylor. Refrig. World, vol. 57, no. 1, Jan. 1922, pp. 21–24. Refrigeration promises only solution of problem of distributing fish from sea to distant consumers in first-class condition. Describes brine freezing process. Brine-frozen versus air-frozen fish.

RESEARCH

Mechanical Engineering Advisory Committee. Mechanical Engineering Advisory Committee for Division of Engineering, Alfred D. Flinn. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 115–116. Describes contemplated program of committee formed within organization of Am.Soc. of Mech.Engrs.

Problems. Research Problems Discussed. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 117–118. Discussion of papers by F. A. Wardenburg and A. D. Flinn. Report of A.S.M.E. work in lubrication, by Albert Kingsbury. Progress in steam-table research described.

ROLLING MILLS

Engines, Combination Gas and Steam. Development of Rolling Mill Engines, F. J. Denk. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 153–154. Advantages of combination of gas engine with steam engine.

Sheet Mills. Apollo Steel Company Enlarge Plant by the Addition of a New Sheet Mill Unit. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 126–130, 9 figs. Describes general layout, buildings, and equipment, including modern improvements in sheet-mill construction.

Extends Facilities for Sheetmaking. Iron Trade Rev., vol. 70, no. 8, Feb. 23, 1922, pp. 532–537, 10 figs. Otis Steel Co. completes eight-mill plant at its Riverside works, Cleveland. Substantial construction of buildings, liberal floor areas for all operations and flexible crane system are outstanding features.

Otis Steel Company Completes the Erection of a Modern Sheet Mill Department, Donald N. Watkins. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 118–122, 7 figs. Located at Riverside plant in Cleveland. Most important installations include extra heavy mills, electric drives, powdered coal fuel, continuous pair furnaces, electric furnace chargers, Baird water-cooled floors, etc.

Tables. Roller Bearings Mill Tables, J. M. Kelly. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 139–141, 2 figs. Describes new rolling mill tables in which were installed flexible roller bearings.

RUBBER

Thermal Insulation. Thermal Insulation of Rubber. Rubber Age, vol. 2, no. 12, Feb. 1922, p. 590. Discusses report by Food Investigation Board of experiments made with onazote.

Vulcanized. Determination of True Free Sulfur and True Coefficient of Vulcanization in Vulcanized Rubber, W. J. Kelly. Jl. Indus. & Eng. Chem., vol. 14, no. 3, Mar. 1922, pp. 196–197. Describes methods of analysis by means of which a more complete study of distribution of sulphur between the various ingredients of rubber compound can be made.

S

SCIENTIFIC MANAGEMENT

See INDUSTRIAL MANAGEMENT.

SHAFTS

Torsional Vibrations. Torsional Vibrations of Shafts (Verdrehungsschwingungen von Wellen), O. Föppl. Schweizerische Bauzeitung, vol. 79, no. 5, Feb. 4, 1922, pp. 56–59, 11 figs. Demonstrates practical applicability of theoretical determination of coefficients of natural vibration of shafts with rotating masses.

SHEARS

Pressure Required for Shearing. Formulas for Pressure Required for Shearing Metal, D. C. Oviatt. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, p. 528, 1 fig. Presents formulas for shear calculation and explains application.

SHERARDIZING

Experiments. Experiments with Sherardizing, Leon McCulloch. Min. & Metallurgy, no. 182, Feb. 1922, p. 63. Study of effect of iron in zinc dust on sherardizing process and on resulting coatings, giving evidence that no part of a sherardized coating can contain less than 6 per cent iron. (Abstract.) See also Am. Inst. Min. & Met. Engrs. Trans., no. 1131-N, Feb. 1922, 4 pp. (complete paper).

SINE BARS

Uses. The Use of the Sine Bar. Machy. (Lond.), vol. 19, no. 488, Feb. 2, 1922, pp. 529–531, 6 figs. Gives some examples of wide range of angle work covered by it. Is more adaptable than the protractor.

SPRINGS

Handling and Heat-Treating. Methods of Handling and Heat-Treating Springs. Can. Machy., vol. 27, no. 8, Feb. 23, 1922, pp. 21–25, 23 figs. Principles governing uniform heating and cooling; type and arrangement of equipment; stationary and continuous furnaces; utilizing heat in waste gases.

Impact Absorption. Graphic Representation of Absorption of Impact by Springs, Leslie H. Mann. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 554–555, 2 figs. Determination of energy absorbed by spring under load based upon assumption that body producing deflection of spring is moving with its center of gravity in line with axis of spring, or in line with point that will cause spring to act most efficiently.

STANDARDIZATION

Advantages. Significance of Standardization to American Industry and the Federal Government, A. A. Stevenson. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 185–186 and 203. Advantages of standardization to all, including Government as largest consumer. How Government should coöperate with industry. What is being done by Am. Eng. Standards Committee.

Waste Elimination through. Waste Elimination Through Standardization, H. Campbell and Alex Taub. Am. Mach., vol. 56, no. 10, Mar. 9, 1922, pp. 363–364. Reducing manufacturing costs. How standardization benefits both manufacturer and consumer. Introduction of universal numbering system. Multiplying service by six.

STEAM

Ruths Storage System. The Ruths Steam Accumulators (L'accumulatore di vapore Ruths), E. C. Constam-Gull. Industria, vol. 35, no. 24, Dec. 31, 1921, pp. 521–527, 17 figs. Various examples of application of this system of equalizing pressure loads; savings effected in fuel.

The Ruths Steam Storage System (Der Ruthssche Dampfspeicher), G. Schulz. Stahl u. Eisen, vol. 42, no. 5, Feb. 2, 1922, pp. 165–171. Writer points out favorable influence on boiler fire effected by a constantly uniform steam consumption in boiler house, which has been verified by tests conducted by Prof. Jossé, Berlin. It is claimed that this uniform steam consumption can, in many cases, be obtained by use of a new steam accumulator which is described.

STEAM ENGINES

Steam Consumption of Reciprocating. The Coefficients of Steam Consumption of Reciprocating Steam Engines (Die Verbrauchzahlen der Kolbendampfmaschinen und ihre Beurteilung), R. Doerfel. Zeit. des Vereines deutscher Ingenieure, vol. 66, nos. 4 and 6, Jan. 28 and Feb. 11, 1922, pp. 84–87 and 133–136, 10 figs. Revisal of rules for efficiency tests. Determination of tolerances. Results of tests on state of resistance. Thermal equivalent according to the law of 1899 and method subsequently in use of determining steam consumption reckoned from zero deg. cent. feedwater temperature or with arbitrary deductions. The Clausius-Rankine comparative method and difficulty of evaluation of waste heat in feedwater and water of condensation of cylinder walls, cover and receiver.

Torsiograph, Measurements with. The Torsiograph and Its Use in Steam-Engine Operation (Ueber den Torsiographen und seine Anwendung im Dampfmaschinenbetriebe), Jos. Geiger. Elektrotechnik u. Maschinenbau, vol. 40, no. 4, Jan. 22, 1922, pp. 40–42, 4 figs. Describes instrument for measurement of deviation of angle, coefficient of cyclic variation and the varying torsional stresses in transmission gears and crankshafts.

STEAM GENERATORS

Electrically Operated. Generation of Steam by Electricity, E. T. Kaelin. Eng. Jl. (Eng. Inst. Can.), vol. 5, no. 3, Mar. 1922, pp. 127–133, 7 figs. Field of use for electric-steam generator, its advantages to consumer from load-factor point of view and to electric supply company as outlet for surplus power. Discusses types of electric-steam generators with particular reference to water-resistance type.

STEAM PIPE

Diameter. The Most Economical Pipe Diameter for Steam-Power Piping (Der billigste Rohrdurchmesser für Kraftdampfleitungen), O. Denecke. Zeit. für Dampfkessel u. Maschinenbetrieb, vol. 44, nos. 49, 50, 51 and 52, Dec. 9, 16, 23 and 30, 1922, pp. 394–396, 405–408, 418–421 and 427–431, 4 figs. Calculation of diameter taking only pipe friction into consideration, and taking separate resistances into consideration. Numerical examples of high-pressure saturated-steam turbines.

STEAM POWER PLANTS

Oil-Burning. Operation of Oil-Burning Steam Plants, C. H. Delany. Iron Age, vol. 109, no. 8, Feb. 23, 1922, pp. 525–527, 4 figs. Discussion of plant characteristic diagram, with particulars regarding its use in establishment of a standard of performance and in increasing plant efficiency. (Abstract.) Paper presented at joint meeting of Am.Soc.Mech.Engrs. and Am.Inst.Elec.Engrs.

STEAM TURBINES

Efficiency Tests of 60,000-Kw. Efficiency Tests of a 60,000-Kw. Turbine, Herbert B. Reynolds and Walter F. Hovey. Power, vol. 55, no. 11, Mar. 14, 1922, pp. 411–413, 4 figs. Results of tests on turbine installed in power station of Interborough Rapid Transit Co. (Abstract.) Paper to be read before Am.Soc.Mech.Engrs.

STEEL

Alloy. See ALLOY STEELS.

Basset Direct-Production Process. Direct Production of Steel (La production directe de l'acier), E.-H. Weiss. Nature, no. 2491, Dec. 31, 1921, pp. 423–427, 5 figs. Describes Basset process as applied at Dennemont works, of producing steel direct from ore.

Cracking. Intercrystalline Cracking of Mild Steel in Salt Solutions, J. A. Jones. Faraday Soc. Trans., vol. 17, part 1, no. 49, Dec. 1921, pp. 102–109, 9 figs. Describes action of various solutions in producing cracking of steel in state of stress.

Failure on Hardening. The Mechanism of the Failure of Steel upon and after Hardening. G. W. Green. Faraday Soc. Trans., vol. 17, part 1, no. 49, Dec. 1921, pp. 139–145, 7 figs. Outlines causes of stressing and subsequent failure.

Fatigue Tests. Endurance of Steel Under Repeated Stresses, D. J. McAdam, Jr. Chem. & Met. Eng., vol. 25, no. 24, Dec. 14, 1921, pp. 1081–1087, 22 figs. Fatigue tests on many commercial and alloy steels develop no evidence of "endurance limit;" ultimate tensile strength closely related to endurance stress at 1,000,000,000 cycles; special White-Souther machine and semi-logarithmic graphs used.

Identification and Storage. A New Idea in Steel Identification and Storage. Ry. & Locomotive Eng., vol. 35, no. 2, Feb. 1922, pp. 44–45, 2 figs. Describes method of marking steel bars for identification, and also designing and constructing suitable steel storage racks, employed by Gould & Eberhardt, Newark, N. J.

Literature, 1921. Review of Iron and Steel Literature for 1921, E. H. McClelland. Blast Furnace & Steel Plant, vol. 10, no. 1, Jan. 1922, pp. 4–8. Classified list of the more important books, serials and trade publications during year, with a few of earlier date, not previously announced. Also in Forging and Heat Treating, vol. 8, no. 1, Jan. 1922, pp. 4–8.

Phosphorus, Influence of. Influence of Phosphorus upon the Microstructure and Hardness of Low-Carbon, Open-Hearth Steels, Edward C. Groesbeck. U. S. Bur. of Standards Technologic Papers, no. 203, Nov. 21, 1921, pp. 1–33, 15 figs. Two series of specimens, one of basic and the other of acid open-hearth steel, with phosphorus content in each series varied in four or five steps within limits 0.008 to 0.115 per cent, which mark the ordinary limits of phosphorus content in plain carbon steel, were employed in study of relationship between phosphorus content and microstructure and hardness resulting from series of different heat treatments tried.

Properties in Hardening Range. Properties of Some Steels in the Hardening Range, W. R. Chapin. Am. Soc. for Steel Treating Trans., vol. 2, no. 6, Mar. 1922, pp. 507–514 and (discussion by Zay Jeffries) pp. 514–515, 4 figs. Report applies only to steels which, when properly quenched, harden throughout mass, and are martensitic when so hardened.

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Wire, Low-Carbon Steel. Ghost Lines and Grain Elongations in Hot Rolled and Cold Drawn Low Carbon Steel Wire, N. B. Hoffman. Am. Soc. for Steel Treating Trans., vol. 2, no. 6, Mar. 1922, pp. 516–523 and (discussion) pp. 523–525, 26 figs. Shows relation existing between ghost lines, bands, and elongated grain structures as found in low-carbon steel wire.

STEEL CASTINGS

Heat Treatment. The Heat Treatment of Steel Castings, Walter H. White. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 437–440. Suggestions for obtaining good results.

STEEL, HEAT TREATMENT OF

Alloy Carbonizing Boxes. Do Alloy Carbonizing Boxes Pay? C. M. Campbell. Am. Soc. for Steel Treating Trans., vol. 2, no. 6, Mar. 1922, pp. 495–499. Considers factors governing life and performance of carbonizing boxes, and reasons why they should not be placed on supply account instead of becoming part of equipment.

Brinell Hardness, Calculating. New Development on the Influence of Mass in Heat Treatment, E. J. Janitzky. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 377–383, 2 figs. Also Iron Age, vol. 109, no. 10, Mar. 9, 1922, pp. 658–659, 2 figs. Suggested formula for calculating Brinell hardness from given data. Applicable to alloy and carbon steels. Paper presented at N. Y. Section of Am. Soc. for Steel Treating.

Carbon Steel. Effect of Heat Treatment on the Mechanical Properties of 1 Per Cent Carbon Steel, H. J. French and W. George Johnson. U. S. Bur. of Standards Technologic Papers, no. 206, Dec. 27, 1921, pp. 93–121, 16 figs. Study of effects of varying time-temperature relations in heat treatment on tensile and impact properties, hardness, and structure of 1 per cent carbon steel, including (a) effect of temperature variations in hardening (b) time at hardening temperatures both above A_{cm} and between the Ac_1 and A_{cm} transformations, (c) effects of tempering steel hardened in different ways and effects of "soaking" just under lower critical range, (d) comparison of oil and water hardening for production of definite strengths.

Effect of Heat Treatment on the Mechanical Properties of One Per Cent Carbon Steel, H. J. French and W. George Johnson. Am. Soc. for Steel Treating Trans., vol. 2, no. 6, Mar. 1922, pp. 467–494, 16 figs. Results of tests show that most suitable oil or water quenching temperature for steel which is subsequently to be tempered at relatively high temperatures is slightly above end of Ac_1 transformation.

Cold-Headed Bolts. Cold-Headed Bolts—Their Metallography and Heat Treatment, W. E. Hillman. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 369–376, 20 figs.; also Iron Trade Rev., vol. 70, no. 8, Feb. 23, 1922, pp. 538–541, 18 figs. Various degrees of distortion may be found in same bolt; however, annealing at 1150 deg. Fahr. will remove weakening effect of cold work. Annealing above critical range is preferable.

Fixtures for. Special Fixtures for Heat Treating, E. H. Tingley. Forging & Heat Treating, vol. 8, no. 2, Feb. 1922, pp. 96–99, 7 figs. Describes a number of appliances for heating and quenching small parts as developed from suggestions made by workmen of Delco-Light Co. heat-treating department.

Structural Changes due to Heating Medium. Influence of the Heating Medium on the Structural Changes in Steel, A. E. Bellis. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 398–401 and (discussion) pp. 401–402. Analysis of structural changes as they are influenced by heating and cooling medium.

STEEL PLANTS

Pressed Steel. Description of a Pressed Steel Plant. Blast Furnace & Steel Plant, vol. 10, no. 2, Feb. 1922, pp. 144–147, 4 figs. Brief history of reorganization of Sharon Pressed Steel Co., Sharon, Pa., equipped to manufacture and assemble heavy pressed-steel products. Routing and handling.

STOKERS

Motion Pictures of Operation. Motion Pictures of a Stoker Furnace in Operation, R. Sanford Riley. Mech. Eng., vol. 44, no. 2, Feb. 1922, pp. 103–104, 4 figs. Describes invention of F. H. Daniels and pictures taken at plant of Bird & Son, Inc., East Walpole, Mass., showing operation of a 9-retort extra long Riley underfeed stoker.

STREET RAILWAYS

Cars, One-Man. One-Man Car Operation with Double-Truck Cars, H. S. Sweet. Elec. Ry. Jl., vol. 59, no. 4, Jan. 28, 1922, pp. 156–158, 9 figs. Describes new one-man car in Utica equipped with turnstiles to admit passengers who pay as they leave. (Abstract.) Paper read before N. Y. Elec. Ry. Assn.

Two New Types of Safety Cars for Chicago, Charles Gordon. Elec. Ry. Jl., vol. 59, no. 2, Jan. 14, 1922, pp. 65–71, 14 figs. Describes single-truck and double-truck one-man safety cars, both arranged for double-end operation with separate entrance and exit passageways.

STRESSES

Flat Cylinder Heads. Stresses and Deformation in Flat Circular Cylinder Heads, Gilbert Dudley Fish. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 165–169 and (discussion) p. 170, 12 figs. Analysis covering homogeneous elastic disks, where form and loading are symmetrical with respect to all diameters, where loading is combination of fluid pressures and of forces acting normally on concentric circles, where thickness is uniform, and where all strains are within limits of true elasticity. Formulas applicable to all cases considered are developed, and equations are given for constants of integration involved in mathematical analysis.

Thermal. The Thermal Stresses in Spherical Shells Concentrically Heated, Charles H. Lees. Roy. Soc. Proc., vol. 100, no. A 705, Jan. 2, 1922, pp. 379–394, 7 figs. Discusses stresses set up in materials by difference in temperature and its application to blast furnaces and others.

STRUCTURAL STEEL

Tensile Properties. Tensile Properties of Some Structural Alloy Steels at High Temperatures, H. J. French. Am. Soc. for Steel Treating Trans., vol. 2, no. 5, Feb. 1922, pp. 409–422, 8 figs. Account of tests conducted by Bur. of Standards to determine tensile properties of a number of structural alloy steels throughout temperature range of 20 to 550 deg. cent.

SWAGING

Hot. Hot Swaging, Fred R. Daniels. Machy. (N. Y.), vol. 28, no. 7, Mar. 1922, pp. 521–526, 10 figs. Describes swaging operations, based on practice and recommendations of the Langelier Mfg. Co., Providence, R. I.

T

TEMPERATURE CONTROL

Automatic Valve. Temperature Regulation by Automatic Valve, G. A. Wegner. A.S.R.E. Jl., vol. 8, no. 3, Nov. 1921, pp. 203–210, 6 figs. Discusses control of a valve through which vapor pressure is made controlling factor, the object being to assist man in charge in his task and to make desired results more certain.

TERMINALS, LOCOMOTIVES

Georgia. An Engine Terminal for Economical Operation, G. W. Tutan. Ry. Age, vol. 72, no. 8, Feb. 25, 1922, pp. 463–467, 7 figs. Describes combined roundhouse and shops of Central of Georgia railroad, including design of enginehouse structure and shop equipment.

TERMINALS, RAILWAY

Freight. Katy Builds Freighthouse of Fireproof Construction. Ry. Age, vol. 72, no. 10, Mar. 11, 1922, pp. 559–561, 7 figs. Describes new inbound terminal of Missouri, Kansas & Texas, at Dallas, Texas.

TEXTILE INDUSTRY

Science in. Science in the Textile Industry. Mech. Eng., vol. 44, no. 3, Mar. 1922, pp. 181–184, 1 fig. Two papers presented before Textile Division of A.S.M.E.: Hidden Wastes in Textile Plants, Thayer P. Gates; and Economy in Textile Drying, B. R. Andrews. Discussion.

TIDAL POWER

Utilization. Using Sea Power (Utilisons la "Houille Bleue"), H. Lémonon. La Nature, nos. 2482 and 2484, Oct. 29 and Nov. 12, 1921, pp. 278–283 and 310–316, 19 figs. Oct. 29: Describes systems of tidal power production by Reynolds, Tommasi, Legrand, Praceiq, etc. Nov. 12: Describes systems depending on use of turbines and hydraulic accumulators.

TIME STUDY

Bedaux Human Power Measurement. The Bedaux Principle of Human Power Measurement, L. C. Morrow. Am. Mach., vol. 56, no. 7, Feb. 16, 1922, pp. 241–245, 2 figs. Describes system practiced by Chas. E. Bedaux Co., Cleveland, Ohio. Application to compensation of labor. Isolation from methods, equipment and piece rates. Simplicity of records.

Motion Study and. Time and Motion Study, Eric Farmer. Eng. & Indus. Management, vol. 7, nos. 3, 4, 5, 8, Jan. 19, 26, Feb. 2, 23, 1922, pp. 70–75, 95–98, 136–139, 221–223. Jan. 19: Review of past works by Taylor and Gilbreth. Jan. 26: New point of view in undertaking time and motion study; reducing unproductive labor. Feb. 2: Correct definition of motion study. Feb. 23: Time study.

TRACTORS

Caterpillar. A New Caterpillar Development, F. Rowlinson. Sci. Am., vol. 126, no. 3, Mar. 1922, pp. 194–195, 8 figs. British efforts to save power and increase speed by means of a track that will yield to local obstacles. Describes new type of caterpillar suspension and its application.

Four-Wheel Drive. A Four-Wheel Drive Tractor from the Pacific Coast. Automotive Industries, vol. 46, no. 10, Mar. 9, 1922, pp. 554–555, 4 figs. Describes the Wizard 4-Pull tractor which transmits power to all four wheels by roller chains and steers by disconnecting power from wheels on one side.

Road-Rail Trucks and. The Stronach Dutton System of Road Rail Traction. Roy. Engrs. Jl., vol. 35, no. 2, Feb. 1922, pp. 93–96, 2 figs. on supp. plates. Principle adopted is to support front axle of a short-wheel base tractor by a four-wheeled bogie running on a Decauville line A drawbar is carried from bogie pivot to back of tractor for attachment of such trucks as can be hauled. Most recent pattern of tractor hauling train and converting from road to rail or rail to road traction.

Samson. Cooling Capacity Increased in Samson Tractor, P. M. Heldt. Automotive Industries, vol. 46, no. 9, Mar. 2, 1922, pp. 502–505, 4 figs. Technical description. Improvements in lubricating and cooling systems; enlarging of radiator and fan; etc.

Types. Tractor Show Marked by New Designs, P. M. Heldt. Automotive Industries, vol. 46, no. 8, Feb. 23, 1922, pp. 451–457, 8 figs. Creeper tractor construction; road-building and maintenance tractors; corn-belt and grain-belt tractor requirements contrasted; new machines and parts described.

TRANSPORTATION

Highway. Highway Transportation. Am. Soc. Civ. Engrs. Proc., vol. 48, no. 2, Feb. 1922, pp. 318–358. Symposium containing following papers: Highway Transportation, Thomas H. MacDonald. Inspection of Highway Construction, William G. B. Thompson. Financing and Bonding Highways, John N. Cole. Highway Bonding from the Viewpoint of the Surety Company, E. A. St. John. Financing and Bonding Highway Work, Edward C. Lunt. The Motor Vehicle in Highway Financing, Harry Meixell. The Motor Truck as an Asset to Railroad Operation, R. S. Parsons. Motor Vehicle Control, G. Wythe Munford. Discussion, W. K. Hatt.

Railway. Railroad Transportation. Am. Soc. Civ. Engrs. Proc., vol. 48, no. 2, Feb. 1922, pp. 288–316. Symposium containing following papers: Railroad Transportation, Howard Elliott. Railroads and Their Employees, W. N. Doak. Railroad Transportation and Owners of Railroad Securities, F. A. Molitor. Discussion, George W. Simmons.

Water. Water Transportation. Am. Soc. Civ. Engrs. Proc., vol. 48, no. 2, Feb. 1922, pp. 266–286. Symposium containing following papers: Water Transportation, R. H. M. Robinson. The American Merchant Marine, Winthrop L. Marvin. The Merchant Marine Problem, Emory R. Johnson. Water Transportation in Its Relation to the Railways, Samuel O. Dunn.

U

UNEMPLOYMENT

Improving Statistics. Suggestions for Improving Employment and Unemployment Statistics, Thomas Warner Mitchell. Management Eng., vol. 2, no. 3 Mar. 1922, pp. 161–166. Present data are shown to be incomplete. Presents unemployment score data sheet devised by author on which to account for potential working time of a given working force for any period of time.

V

VALVES

Gate, Electrically Operated. Tests on Motor-Operated Gate Valves for High-Pressure Steam, T. W. Stinson. Power, vol. 55, no. 7, Feb. 14, 1922, pp. 263–265, 5 figs. Emergency-closing tests made on five motor-operated 6-in. to 10-in. gate valves, against steam at 225 lb. pressure and 150 deg. Fahr. superheat blowing to atmosphere.

VENTILATION

Effect of CO in Air. The Physiological Principles Governing Ventilation When the Air is Contaminated with Carbon Monoxide, Yandell Henderson and Howard W. Haggard. Jl. Indus. & Eng. Chem., vol. 14, no. 3, Mar. 1922, pp. 229–236, 5 figs. (Abstract.) Report to Chief Engineer of New York & New Jersey Tunnel Commissions.

VENTURI METERS

Air and Gas Measurement. The Metering of Large Volumes of Air and Gas By Means of the Venturi Tube, John L. Hodgson. Instn. Min. Engrs. Trans., vol. 62, Part 3, Jan. 1922, pp. 208–218 and (discussion) 218–220, 9 figs. Account of application of Venturi meter.

VIBRATION

Fixed Members. The Natural Vibrations of Fixed Members of Variable Cross-Section (Die Eigenschwingungen eingespannter Stäbe von veränderlichem Querschnitt), N. Mononobe. Zeit. für angewandte Mathematik u. Mechanik, vol. 1, no. 6, Dec. 1921, pp. 444–451, 3 figs. Describes method for calculating transverse oscillations of elastic members with variable cross-section. Formula is derived which permits calculation of oscillating frequencies of members of relatively complicated form by making use of the oscillating frequency of similar truncated cones. Useful in calculating effect of vibrations in slender structures, such as chimneys, towers, etc., caused by earthquakes.

VISCOSIMETERS

Conversion Chart. Viscosimeter Conversion Chart. Power, vol. 55, no. 10, Mar. 7, 1922, p. 377, 1 fig. Presents chart for finding viscosity reading of a particular oil on any of standard viscosimeters when its reading on one of viscosimeters has been determined by experiment at same temperature.

VOCATIONAL TRAINING

Seasonal Industries. A Management Problem in Seasonal Industries, D. W. Rockey. Indus. Management, vol. 63, no. 2, Feb. 1922, pp. 77–79, 1 fig. Problem of seasonal industries is to efficiently teach large increases of working forces in minimum of time. Solution of problem is training of largest possible corps of instructors, both as to instructional methods and as to operating procedure and organization.

W

WASTE

Causes and Reduction. A Campaign Which Cut Wastes in Half, Peter F. O'Shea. Factory, vol. 28, no. 3, Mar. 1922, p. 281. Tells how nearly 50 per cent of entire yearly waste bill was reduced by Dennison Mfg. Co. by a systematic following up of twelve causes of waste.